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	PAGE
The Teacher and Reconstruction	141
Ideals for Teachers	142
The Maharajah of Travancore Lecturership in Applied Chemistry	142
Sir Ardeshir Dalal	143
New Developments in Plastics	143
Obituary—Acharya Sir Prafulla Chandra Ray	144
Intellectual Workers' Union	144
The Four Forms of Diamond. By SIR C. V. RAMAN	145
A New Punjab Oil-Field	148
An Early Reference to Night-Blindness in India, and Its Relation to Diet Deficiency. By W. R. AYKROYD	149
Coconut Shells as an Industrial Raw Material—III. Estimated World Production. By DR. REGINALD CHILD	150
Similarities between the Excitation Phenomena in Unstriated Muscle and Those in the Retina. By INDERJIT SINGH	152
Letters to the Editor	154
Cyclewelding—A New Bonding Process	163
Reviews	164
Central Sugarcane Committee	166
Science Notes and News	167

THE TEACHER AND RECONSTRUCTION

AMIDST the world-wide struggle which has continued to rage with all the ferocity of a modern war, plans for post-war reconstruction are being forged by all nations. Rehabilitation, currency, form of government, industrialisation, transport, markets, food production, health, employment and social security, have, each of them, been receiving their share of attention at the hands of the several expert committees set up for investigation and report. The problems of education, in its various aspects, the type of education to be imparted to the rising generation, education for enlightened world-citizenship, education for research and industry, education for character and culture, and education for peace, are being widely discussed by the public and the press. Leading educationists are examining the problem of education in the light of the new world order which prominent thinkers and statesmen are visualizing.

It is generally recognised that the present system has many inherent defects. To prevent a recurrence of the war and secure an ordered progress of the world, the system of education needs to be modified. Education of the youth is the vital foundation on which the progressive, peaceful and humane reconstruction should be organised; it is only through a well-conceived system of liberal and humanising education that the long-cherished hope of maintaining ever-lasting peace and of securing universal prosperity can be fulfilled.

In India the problem of educating the 400 millions and raising their economic standard, has received the earnest attention not only from the Government but also from our national leaders. The Wardha Scheme, inspired by Mahatma Gandhi, is intended to unfold the full personality of the individual and qualify him for a creative and corporate life in a democratic community. The Sargent Scheme lays down a plan through which the nation is prepared to shoulder the responsibilities of a modern democratic administration. The Sargent Plan which incorporates a good many important points outlined in the Wardha Scheme, has earned for itself the reputation of constituting one of the most practical and comprehensive schemes ever evolved for educating the people of this land. In addition we have the post-war reconstruction schemes pertaining to every department of nation-building, post-war agriculture, post-war industrialisation, and post-war plans for scientific and industrial research. Leading industrialists of this country have put forward the fifteen-year, 10,000 crore scheme, generally known as the "Bombay Plan", for the industrial regeneration of this country.

These gigantic schemes need the services of an army of trained personnel, teachers, technologists, administrators, and scientific men. To reap the full benefits of a democratic way of life, and of the four freedoms which are enunciated as the birthright of every nation on this globe, the people must be educated and illiteracy which, in this country, exists to the extent of 85 per cent. removed. In the abolition of illiteracy and in the training of personnel to man the schemes of reconstruction, it is the humble teacher that has to play the fundamental role. The teachers lay the foundation

of the edifice of national regeneration and national prosperity. They constitute the master instruments through which reconstrucion plans have to be put through. These facts are not generally recognised to the extent they should be and strangely enough, the profession of teaching, in spite of the vital and strategic position which it occupies in the body politic, still remains one of the most unremunerative of the learned professions. It is argued that there are no financial prizes, such as men strive for in business. The teacher must find his reward not in the form of high salaries or accumulated fortunes but in the intellectual life of the scholar, "in the fellowship of cultivated colleagues in the companionship of young minds and young hearts" and in the gratitude and friendship of his students. These are worthy ideals which most teachers appreciate and practise when they are provided with adequate means for leading a life of dignity and modest satisfaction. But when the teacher is faced with the spectre of domestic penury, as he is to-day in India, and when he has to run the risk of an uncertain future for himself and his dependants, he naturally feels neglected and discouraged.

It is flattering neither to a progressive state marching towards democracy, nor to an enlightened public aspiring for freedom, that the teacher who constitutes the central figure destined to ultimately influence every sphere of nation-building, should find himself neglected, unrecognised and in a condition of abject poverty. Elsewhere in this issue (p. 162) Sir S. S. Bhatnagar has drawn pointed attention to the lamentable conditions, which characterise the economic status of the teacher in this country. Relevant portions of a letter to him from a science teacher are also reproduced in this issue (p. 163). A grave situation has arisen; immediate relief should be provided.

Progressive nations have realised that teachers constitute by far the most powerful instruments through which a people may control its future destiny. The teacher is the animating force which kindles in the young the passion for knowledge, freedom, truth and justice. The teacher in Japan enjoys the privilege of being the first to be interviewed by the Emperor when he visits a village. The economic condition of teachers in other countries are far more satisfactory than what their Indian compeers enjoy in this country. Americans, in particular, have recognised the value of teachers in a most effective and practical manner. There is the Carnegie Foundation for the advancement of teaching, which takes upon itself the task of protecting and promoting the interests of the community's most precious asset—the teacher.

Andrew Carnegie, the illustrious American benefactor, wrote to his trustees on April 16, 1905, "I have reached the conclusion that the least rewarded of all professions is that of the teacher in our higher educational institutions. I have therefore transferred to you and your successors, as trustees, ten millions of dollars, of five per cent. Mortgage bonds of the United States Steel Corporation, to provide retiring pensions, for the teachers of universities, colleges and technical schools in our country, Canada and Newfoundland, under such conditions as you may adopt from time to time". Later, the gift was increased to fifteen millions of dollars. Is it too much to expect that some of our enlightened industrial magnates will likewise come forward to retrieve a situation which is growing worse day by day? The Central Government and the informed public should take up this matter and reorganise the teaching profession in a manner which will restore it to its rightful place in society.

IDEALS FOR TEACHERS

ADDRESSING the Secondary School Teachers' Association, Sir S. Radhakrishnan, Vice-Chancellor of the Benares Hindu University, said: "I believe the teaching profession, whatever may have been its past, has a very great future before it. Education is the main thing by which we can develop radically new types of men, if we so desire. We have our own system of education and our ideals. People might come forward and ask us: Is it any good pursuing your own ideal at the present moment? I must say that the political and economic condition of India need not be regarded as invalidating the spirit of Indian culture any more than the present war may be said to invalidate the spirit and the value of science. We do not say because the world is at war and science is being abused, therefore science is invalidated. We cannot say that because we are in the present unfortunate condition politically and economically, the ancient Indian wisdom is futile. We require the wisdom—enlightenment as well as knowledge—that is power. If we have failed, it is because our philosophy or our wisdom did not have enough practical application. If science has failed, it is because science has not looked to philosophy for guidance. A combination of these two will help our own country."

THE MAHARAJAH OF TRAVANCORE LECTURERSHIP IN APPLIED CHEMISTRY

A GRANT of Rs. 3,000 per annum has been sanctioned by the Government of Travancore to the Indian Institute of Science, Bangalore, for three years from 1120 (1944-45) for a Lecturership in the Department of Applied Chemistry, to be called "The Maharajah of Travancore Lecturership in Applied Chemistry."

SIR ARDESHIR DALAL

EVERY section of informed public opinion, and the scientists and industrialists in particular, will warmly welcome the statesman-like decision of the Governor-General to invite Sir Ardeshir Dalal to accept the membership of the Executive Council and assume charge of the newly created Department of Planning and Development.

The Government have felt that planning for the post-war period has now reached a stage at which it requires the exclusive attention of a separate member who will be free from the ordinary Departmental routine.

Sir Ardeshir Dalal is not only an eminent administrator of outstanding ability but an experienced industrialist with an intimate practical knowledge of the industrial needs of this country. He has been closely associated with everyone of the great industrial enterprises of the Tatas and has kept himself in sympathetic touch with the progress of scientific and industrial research. He was elected General President of the Indian Science Congress held in Benares in 1941. He has taken a keen and lively interest in guiding the policy and affairs of the Council of Scientific and Industrial Research and in giving practical shape to the National Laboratories.

As one of the distinguished signatories of the much discussed fifteen year, 10,000 crore "Bombay Plan" for India's industrial regeneration and social advancement, he is fully conversant with the national aspirations in this regard. His wide and varied administrative experience will, at the same time enable him to realise the difficulties which are bound to be encountered in practical materialisation of the plan. Sir Ardeshir Dalal's appointment as Member will be acclaimed as a practical proof of the Government's earnestness to approach the nationalistic plan of post-war reconstruction with sympathy and understanding.

NEW DEVELOPMENTS IN PLASTICS

A U.S. manufacturer is producing plastic helmet liners for the Army by a simple process, using low-cost molds. In a preforming operation, resin-impregnated cotton ribbons are wcund around a hot, oval mandrel by automatic wrapping machines. The fabric "melon" so produced is cut into halves, each a helmet preform. Instead of employing hydraulic presses and elaborate machined steel dies, the company built several inexpensive steel frames. A fixed platform is bolted to the top of the frame, and a movable platform, actuated by means of a small air cylinder, rides between the frame mombers at the bottom. The cavity of the mold is permanently mounted on he upper platform, and is merely a rough cast iron shape which is chrome plated so that a high finish may be imparted to the completed piece. The force plug of the mold is also a rough casting, somewhat smaller in size than the inside of the helmet liner. Both the force plug and the upper mold cavity are cored for steam. In the molding operation, first a rubber bag and then the preform itself is placed over the force plug, and the mold is closed. Water of 250 pounds per square inch (17·6 atm.) flows between the plug and the bag; thus, the pressure necessary for molding is obtained. Heat is transferred from the steam-heated plug through the water to the helmet liner. After a six-minute curing cycle, the pressure is released from the rubber bag and the lower platform dropped, whereupon the liner is released by blown air. One girl operator easily manages seven presses.

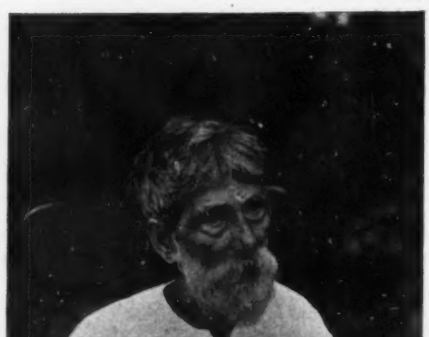
By the wound preform and air bag method, an estimated 15 to 20 per cent. saving in materials is effected. The fabric will not be crushed, but simply be compressed together to a uniform thickness, free from wrinkles, with a more even distribution of fabric and resin. The method is ideal for producing irregular shapes such as curves and globular forms and is highly adaptable to the production of small lots of high-strength parts to be produced quickly and cheaply. It is expected that this type of construction will prove significant in post-war production of furniture, cars, refrigerators and many other pieces of unusual contours.

OBITUARY

ACHARYA SIR PRAFULLA CHANDRA RAY

(Aug. 2, 1861—June 16, 1944)

IT is with the deepest regret that we record the death of Acharya Sir Prafulla Chandra Ray, at the age of 83. He passed away at the University College of Science, Calcutta, which has been both the home in which he lived and the place where he carried on his scientific work.



An eminent chemist, an inspiring teacher, a distinguished educationist, a pioneer industrialist, a great patriot and a noted philanthropist, Acharya Ray occupied an unique position in the scientific, industrial and cultural life of this country. He belonged to that generation of our great men who wrought a great change in the spirit of our age.

His monumental work on the *History of Hindu Chemistry* served to remind his countrymen of the great traditions of chemical research which they had inherited and inspired them to further achievement on modern lines.

He was a sincere friend of the poor and the destitute. He identified himself with the organisation of several relief measures for the amelioration of the economic distress which followed floods, famines and other disasters. His heart and purse were freely available to those who sought them. He had bequeathed the entire proceeds from his salary, aggregating to a few lakhs, to the University of Calcutta as an endowment for expanding the laboratories at the University College of Science and for the advancement of research in general.

He responded to the call of Mahatma Gandhi and threw himself heart and soul in spreading the message of *Charka* and *Khaddar* throughout the length and breadth of this country.

The greatest and the most enduring of his contribution to the advancement of science and industry in this country is the founding of a school of research in chemistry. To quote Gandhiji, "In the death of Dr. P. C. Ray the country has lost a very great scientist and an equally great philanthropist. He was also a great patriot and a friend of the poor. His spartan simplicity was a pattern for all, but more especially for the student world."

We are grateful to Sir J. C. Ghosh, Kt., D.Sc., F.N.I., Director, Indian Institute of Science, for permission to reproduce this exclusive and characteristic portrait of Acharya Ray.

INTELLECTUAL WORKERS' UNION

PROF. ALBERT EINSTEIN has suggested formation of an "Intellectual Workers' Union" in a statement to the National Wartime Conference. The father of the Relativity Theory said, the Union would be designed "to fight for the establishment of a supernational political force as protection against fresh wars of aggression. Intellectual workers should unite not only in their own interests but also, and no less importantly, in the interest of society as a whole. It is inevitable, in considering the progressive centralisation of production, that the economic and political struggle should become more closely interwoven. Meantime, the intellectual worker, due to his lack of organisation, is less well protected against arbitrariness than the member of any other calling. The division among intellectuals partly is to blame for the fact that the special experience which is the birthright of those groups so seldom is seen to be available for political aims. Political ambition and desire for profit almost exclusively determine events, instead of professional knowledge and judgment based upon objective thinking."

THE FOUR FORMS OF DIAMOND*

By Sir C. V. RAMAN

FROM the earliest times, the diamond has rightly been recognized as Nature's choicest product in the mineral world. Its claims to the attention of the scientific investigator are also of the strongest kind. The crystal form and the structure of diamond afford the clearest possible proof of the tetrahedral symmetry of the carbon atoms and the most striking illustration of their quadrivalence and of their capacity to combine with each other in limitless number. To the physicist, diamond is the prince of solids, and the study of its properties opens up many new pathways of knowledge into the domain of the crystalline state of matter.

Purely crystallographic considerations indicate that the structure of diamond should have four possible forms. This follows at once from the fact that the structure may be described as a repetition pattern in which the unit consists of *two* carbon atoms, each of which possesses only tetrahedral symmetry. The four axes characteristic of such symmetry have both direction and sense, and while the directions are necessarily the same for the two representative atoms, the senses may be different, and we have, therefore, 2×2 or four possible settings in space of these axes relative to each other. In two of them, the crystal as a whole would have only tetrahedral symmetry, and they may be described in the language of geometric crystallography as the positive and negative tetrahedral forms, which are physically identical, and are only geometrically different from each other. In the other two settings which are both physically and geometrically different from each other, the crystal would have full octahedral symmetry.

These theoretical considerations are confirmed in a remarkable way and independently by the crystallographic evidence, and by the spectroscopic behaviour of diamond. The appearance of crystal forms characteristic of ditesseral polar symmetry had led the earlier crystallographers to assign to diamond only the lower or tetrahedral symmetry and to explain the frequent appearance of octahedral forms as due to interpenetration twinning of the positive and negative tetrahedral forms. The correctness of their verdict, at least as regards the majority of diamonds, is triumphantly vindicated by the spectroscopic evidence, which shows that the characteristic lattice frequency of 1332 cm.$^{-1}$ is *active* in infra-red absorption in most diamonds. It is known, however, that, in some diamonds, this characteristic frequency is infra-red *inactive*, thereby indicating that such diamonds possess the full octahedral symmetry of the cubic system. Theory indicates, however, that *the characteristic frequency should be active in light-scattering in both cases*, and this again is in agreement with experiment. The evidence thus makes it clear that the considerations set forth above stand on an irrefutable basis.

The energy of binding of the carbon atoms with each other, though of a covalent nature, is essentially of electrostatic origin. Hence, if the distribution of static charge were noticeably different in the different possible structures, they would easily be distinguishable from each other by such simple tests as density or refractivity. Since this is not the case, we are led to recognize that the differences are of a more subtle kind, and are probably connected with the configuration of the orbits and the intrinsic spins of the electrons within the crystal. Diamond is diamagnetic, and the orbits and spins must be so arranged that the magnetic moments associated with them cancel out in the aggregate. In the structures having only tetrahedral symmetry, the individual moments associated with the carbon-carbon bonds should persist, while the aggregate moment vanishes by reason of their tetrahedral setting in space. On the other hand, an octahedral symmetry of structure is only possible when the magnetic moments associated with each carbon-carbon bond cancel out individually.

The close similarity in structure of the four possible forms of diamond suggests that the simultaneous appearance of two or even all four in an individual diamond should be a common occurrence. The least disturbance to the regularity of crystal structure would occur when the positive and negative tetrahedral forms interpenetrate, since these are physically identical. The interpenetration would occur without setting up strains in the crystal, and such a diamond should, therefore, appear isotropic when examined under the polariscope. On the other hand, the two forms having octahedral symmetry being physically different, their mutual interpenetration may be expected to take the form of an alternating or lamellar twinning, and even the smallest difference in the lattice-spacings of the two forms would result in such twinning making itself evident under the polariscope by reason of the birefringence set up. Interpenetration of the tetrahedral and octahedral structures also should give rise to observable birefringence on account of the physical differences between them. These inferences from the theory are found to be in complete accord with the facts.

Apart from the birefringence resulting from the interpenetration of structures differing from each other as explained, there are other physical properties which arise from, or are influenced greatly by, such interpenetration. Amongst these should be mentioned specially the power of the diamond to luminesce or emit visible light under ultra-violet irradiation or the impact of X-rays, the extent of transparency of the diamond in the visible and the ultra-violet regions of the spectrum, its photoconductivity under visible or ultra-violet irradiation, and the reflecting power of the crystal planes for X-rays. The symposium contains reports of

* "Symposium on the Structure and Properties of Diamond," *Proc. Ind. Acad. Sci.* **A**, May 1944, p. 189–342, and Plates III to XXX.

investigations on all these topics. Not only are these properties capable of enormous variations from specimen to specimen, but such variations may also occur within an individual crystal or cleavage plate of diamond. Thus the possibility arises of individual diamonds exhibiting *patterns of luminescence, patterns of ultra-violet transparency,* and *patterns of X-ray reflection or X-ray topographs.* The discovery of the existence of such patterns and of the similarities and differences between them as observed in the same diamonds forms a notable contribution to the physics of the diamond made in the symposium. Numerous photographs of them are reproduced together with the catalogue numbers of the diamonds to enable the reader to compare the different kinds of patterns of the individual diamonds.

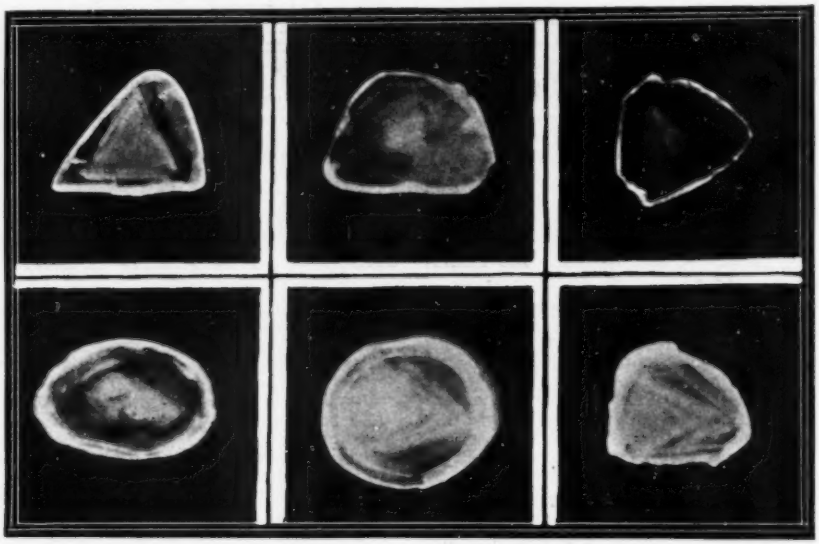


FIG. 1. Luminescence Patterns in Diamond

The luminescence of diamond in its various aspects forms the subject of a series of papers in the symposium. The intensity as well as the colour of the luminescence is highly variable, while some diamonds are definitely non-luminescent. A very thorough investigation by Miss Anna Mani shows that the spectral character of the emitted light may be described in terms of two distinct systems, which may be referred to as the blue and the yellow luminescence spectra. The former is associated with a sharp bright line at 4152 Å, while the latter is similarly associated with a sharp bright line at 5032Å, these being in each case accompanied by subsidiary lines and bands. The absolute and the relative intensities of the 4152 and the 5032 systems vary enormously from diamond to diamond, thus fully accounting for the observed variations of the colour and intensity of luminescence. While the 4152 system alone appears in some diamonds giving a blue luminescence, the 5032 and the 4152 systems invariably appear together when the luminescence exhibits other colours such as green or yellow. No trace of either system is recorded with non-fluorescent diamonds.

An explanation for these facts comes directly out of the theory indicated above. Blue luminescence arises whenever the tetrahedral structures interpenetrate into one another. On the other hand, the lamellar twinning of the octahedral structures produces no luminescence; but if the octahedral structure intermingles with the tetrahedral, then yellow luminescence results. In an actual specimen, the nature and extent of the interpenetration of the different structures may vary, and this is the origin of the high variability of the intensity and colour of fluorescence. Precisely the same explanation is sufficient to account for the patterns of luminescence exhibited by many diamonds. The local variations of colour and intensity in such cases clearly arise from corresponding variations in the structure of the diamond.

The foregoing interpretation of the origin of luminescence in diamond and of the appearance of luminescence patterns therein finds a striking confirmation in the results of a spectroscopic study of the ultra-violet transparency of diamonds by Sunanda Bai, and of direct observations of the transmission through diamond of the 2537 Å radiations of the mercury arc made by Mr. Rendall. It is found that blue-luminescent diamonds are invariably of the ultra-violet opaque type; but the opacity diminishes with increasing intensity of luminescence. The spectrum shows a cut-off at 3050Å in weakly blue luminescent diamonds, but progressively extends into the ultra-violet in intensely luminescing diamonds even up to

2450 Å. The non-fluorescent diamonds are ultra-violet transparent, transmitting freely up to 2250Å, or even beyond. On the other hand, in diamonds of the yellow luminescing kind, the transparency in this region is very imperfect. A strong absorption doublet, accompanied by subsidiary bands on either side appears at about 2360 Å in diamonds that show both the 4152 and the 5032 systems.

diamond. Such variations have in fact been made manifest by a new method of obtaining Laue reflections using X-rays diverging from a pinhole, adopted by Mr. G. N. Ramachandran. By suitably tilting the crystal, and the photographic plate, an almost perfect reproduction (X-ray topograph) of the variations in the crystal structure can be obtained. A comparison of these topographs with the other patterns

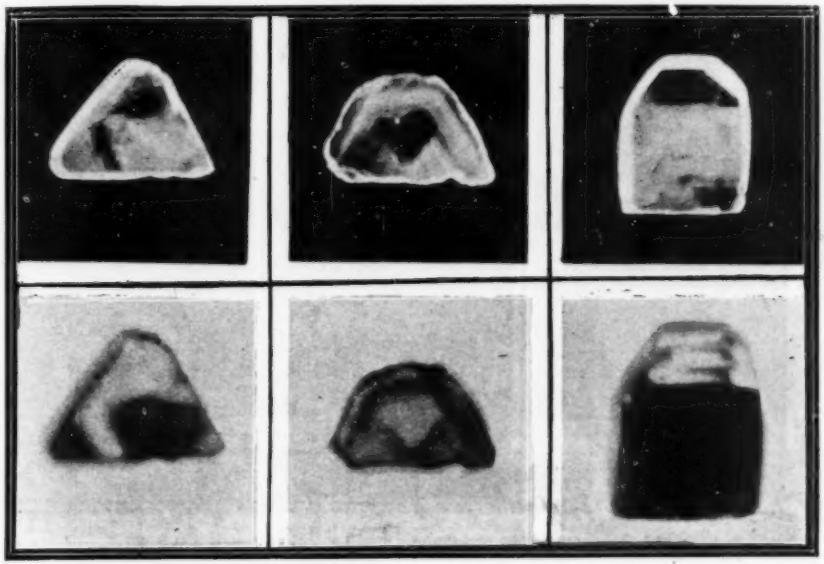


FIG. 2. Comparison of Luminescence and Ultra-Violet Transparency Patterns

X-ray studies furnish a further striking confirmation of the ideas stated above. As already described, the two tetrahedral structures can interpenetrate freely without setting up stresses in the crystal. Nevertheless, the mixed structure is not ideally homogeneous, so that its lattice planes should give stronger X-ray reflections than those given by either structure individually, the intensity being larger, the greater the extent of interpenetration. Hence, one should expect a close correlation between the intensity of blue-luminescence, and of X-ray reflection. This inference has in fact been confirmed by Dr. R. S. Krishnan both by the Laue and the Bragg methods. The interpenetration of the octahedral structures, on the other hand, sets up strains in the crystal, so that such a mixed structure should show much more intense X-ray reflections than the blue-luminescing diamonds. For the same reason, the yellow-luminescent diamonds should exhibit an X-ray reflection intermediate between the above two types. These conclusions have also been borne out by the investigations of Mr. P. S. Hariharan. A natural consequence of the above considerations is that one should also expect variations in the X-ray reflecting power over the area of a cleavage plate of

is very interesting, and shows that the enhanced intensity may be of two types. It may be caused either by an increased interpenetration of the tetrahedral structures or by the intrusion of the octahedral type. Mr. Ramachandran has found that this increase is different for the different crystal planes, the factor of increase being greatest for those having the largest structure-amplitude, and decreasing to unity for feebly reflecting planes.

Observations of the characteristic streaky biretringence of the ultra-violet transparent type of diamond suggests that it has a piezo-optic effect due to the crystal spacings of the two modifications of octahedral diamond being different from each other. We should expect on this basis that the optic axes of the birefringence should be parallel and perpendicular to the intruding layers, and this is actually the case. It is gratifying also to be able to report that direct experimental proof has been obtained for the difference in the lattice spacing of the two octahedral modifications. Using the oscillating crystal method, and a diamond in which the two structures coexist in adjacent layers of the crystal, Dr. Krishnan has found that the Bragg reflections exhibit a waviness, showing clearly that there is a

difference in the crystal spacing of the alternate layers. These observed differences suggest that there should also be a difference in the spectral frequency of the lattice vibrations. Dr. Krishnan has also obtained evidence of this by a careful study of the width of the 1332 line observed.

cies calculated from Dr. Krishnan's results are found to agree well with the frequencies deduced from fluorescence spectra by Dr. Nayar and Miss Mani. Using the experimental values for the fundamental frequencies, Mr. Bisheshwar Dayal has evaluated the specific heat of diamond, the calculated values agreeing per-

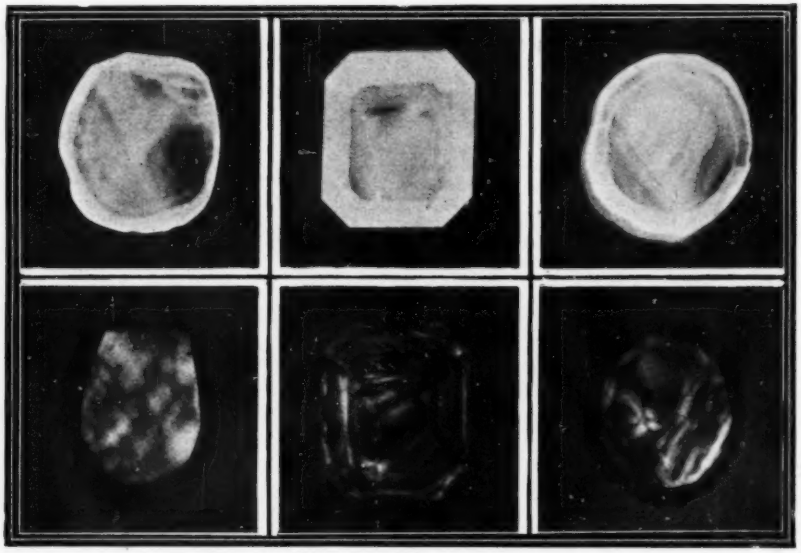


FIG. 3. Comparison of Luminescence and Birefringence Patterns

Reference must also be made to other results of importance announced in the symposium. Dr. Krishnan has studied the scattering of light in diamond in great detail, using the Rasetti technique, and has obtained ten other lines, besides the well-known line with a frequency shift of 1332 cm.$^{-1}$ These new lines have been identified as the octaves and the allowed combinations of the eight frequencies of oscillation of the diamond structure, calculated according to the principles of crystal dynamics developed by the present writer. These lines are not permitted to appear as fundamentals in light-scattering by reason of the selection-rules, but appear in fluorescence in combination with electronic frequencies. The frequen-

fectly well with the experimental data throughout the entire range of temperatures.

There is only space here for a brief reference to a paper by Mr. A. Sigamony on the magnetic susceptibility of diamond, and to two papers by Mr. Pant on the photoconductivity of diamond. The latter has studied the photoconductivity of a large number of diamonds, and has interpreted his results on the basis of the variations in the structure of the crystal as described above. Mr. Ramaseshan reports some interesting studies of the crystal forms of the Panna diamonds, and particularly of the nature of the curvature exhibited by their surfaces.

A NEW PUNJAB OIL-FIELD

A CABLE from London to Mr. D. N. Wadia from Mr. E. S. Pinfold, Chief Geologist of the Attack Oil Co., announces the successful results of the boring tests proving the existence of natural oil (petroleum) at Joya-Mair village, near Chakwal, in North-West Punjab. This area was geologically suveyed in course of his Potwar Survey by Mr. Wadia, who discovered this favourable oil-storage structure at Joya-Mair and reported it to the Government in 1926, suggesting this area as a possible oil-field in a paper published in the *Records, Geological Survey of India*, in 1929. For fourteen years this discovery remained untested by actual drilling trials.

AN EARLY REFERENCE TO NIGHT-BLINDNESS IN INDIA, AND ITS RELATION TO DIET DEFICIENCY

By W. R. AYKROYD
(Nutrition Research Laboratories, I.R.F.A., Coonoor)

REFERENCES to the treatment of night-blindness by liver are to be found in ancient medical writings. In an Egyptian medical treatise, Eber's Papyrus, to which the date 1500 B.C. has been assigned, the roast liver of an ox, and the liver of a black cock, are mentioned as curative agents. Hippocrates recommends "ox liver, raw and dipped in honey". The curative effect of liver on night-blindness appears, indeed, to be part of traditional medical lore in many parts of the world including India.

After the discovery of vitamin A in the present country, the association between night-blindness and vitamin A deficiency was established and an explanation provided of the efficacy of liver in the treatment of the condition. Later work revealed that vitamin A is required for the regeneration of visual purple, which sensitises the retina for vision in dim lights. A large amount of inconclusive work has been carried out on dark adaptation tests to detect early evidence of vitamin A deficiency. There are other causes of night-blindness besides vitamin A deficiency and the physiological process of dark adaptation is a complicated one. But unquestionably there is a classical form of night-blindness, occurring in malnourished people, which responds to treatment with vitamin A in the form of liver or liver oil, and other concentrated sources of vitamin A and carotene. The response in the classical conditions is often dramatic; the tradition of the value of liver could scarcely have been established unless this were so. The author[1] has described night-blindness among Newfoundland fishermen living on a diet deficient in vitamin A. The fishermen treated themselves by taking cod liver oil, cod liver, seal liver, hen's liver, gull's liver, etc., and by such means cured themselves to their own satisfaction within 24 to 48 hours. It is possible, of course, that dark adaptation did not become completely normal within this short period, but a fisherman on a dark and rocky coast cannot to any serious extent deceive himself and his comrades about the acuity of his night-vision.

Much of the recent work on dark adaptation has been carried out on relatively well-nourished individuals who were not night-blind in the clinical sense—*i.e.*, their condition was not such as to lead to social disability because of failure to see in a dim light and impel them to seek treatment. Investigations have been concerned largely with minor degrees of impairment of dark adaptation detectable only by refined dark adaptation tests. Under such conditions no very clear-cut relation between impaired dark adaptation and diet deficiency has been observed. The growth of the literature describing experimental work along these lines has tended to obscure earlier clinical observations on night-blindness which clearly showed that there is a common form of the disease occurring in malnourished subjects and responding to treatment with vitamin A. It is, therefore, interesting to find that the dietetic origin of night-blindness (or of one kind of night-blindness) was recognised in India over a hundred years ago.

The passage quoted below is from "Narrative of a Journey through the United Provinces of India from Calcutta to Bombay, 1824-25", by the Right-Rev. Reginald Heber, Lord Bishop of Calcutta (Third Edition, 1828, Vol. 11, p. 485). The town referred to is Chitoor in Rajputana.

> "In our way back through the town a man begged of me, saying that he was blind. On my calling him, however, he came forwards so readily to the torches, and saw, I thought so clearly, that I asked him what he meant by telling me such a lie. He answered that he was night-blind (*'rat unda'*), and I, not understanding the phrase, and having been a good deal worried during the day with beggars, for the whole fort is a swarm of nothing else, said peevishly, 'darkness is the time for sleep, not for seeing'. The people laughed as at a good thing, but I was much mortified afterwards to find that it was an unfeeling retort. The disease of night-blindness, that is, of requiring the full light of day to see, is very common, Dr. Smith said, among the lower classes in India, and to some professions of men, such as soldiers, very inconvenient. The Sepoys ascribe it to bad and insufficient food, and it is said to be always most prevalent in a scarcity. It seems to be the same disorder of the eyes with which people are afflicted who live on damaged or inferior rice, in itself a food of very little nourishment, and probably arises from a weakness of the digestive powers. I was grieved to think I had insulted a man who might be in distress, but Dr. Smith comforted me by saying that, even in respect of night-blindness, the man was too alert to be much of a sufferer from the cause which he mentioned."

Bishop Heber, author of the well-known hymn which begins "From Greenland's icy mountains", was unquestionably a remarkable man, who when not occupied in establishing missions and preaching long sermons, studied the people, social customs, archæology, and agriculture of India with eager scientific curiosity. His dynamic career came to an early close. He died of apoplexy at the age of 43 in a swimming bath at Trichinopoly, having entered the bath to cool himself off after a strenuous morning occupied in devotional and administrative duties. The bath, with a commemorative inscription to Bishop Heber, is still in existence.

Dr. Smith I have not been able to trace. He was an army doctor who joined the bishop's party at Meerut and proceeded with it to Bombay.

The striking part of the quotation is the statement that the Sepoys recognized that

night-blindness is a food deficiency disease. This is rather a different thing from traditional knowledge of the value of liver in treatment. To the best of my recollection, the Newfoundland fishermen, while they knew how to cure night-blindness by liver, did not clearly understand that it was caused by their poor diet, and in other parts of world knowledge of the method of treatment does not seem to have involved recognition of etiology. The passage may, therefore, be worthy of a place in the history of ophthalmology and nutrition.

1. *Jour. Hyg.*, 1930, **30**, 357.

COCONUT SHELLS AS AN INDUSTRIAL RAW MATERIAL

III. ESTIMATED WORLD PRODUCTION

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THE first of this series of articles[17] dealt with the chemical composition of coconut shells; and the second[31] with miscellaneous uses of shells as such and with their value as fuel.

It is convenient at this stage to consider briefly the world output of coconuts and the corresponding availability of coconut shells, since in discussing (in latter articles) potential utilization of shells it is necessary to have a working idea of the quantities produced.

WORLD PRODUCTION OF COCONUTS

Estimates of world production are not very precise. Fairly good statistics are available for the Philippines prior to the Japanese occupation, and the writer's estimates (1939)[32] for Ceylon are believed to be reasonably near the truth. Statistics are usually available for exports of coconut products from countries of origin; local consumption is, however, very difficult to estimate.

Probably the most ambitious attempt to assess world production of coconuts has been that of Leo Schnurmacher, Inc., of the Philippines (1938)[33] and the following table is to a large extent adapted from their publication: (1939),[35] which are only concerned with commodities entering world commerce.

It will be observed that, according to Table I, six major producing countries account for the bulk of world production, and it is certain that these countries provide over 90 per cent. of coconut products entering world trade.

AVERAGE WEIGHT OF SHELLS

Coconuts vary considerably in size, the greatest differences being varietal. Varieties range from the dwarf types, which may weigh as little as 250 grams per husked nut, to the large San Ramon nut of the Philippines, which when husked may weigh as much as 2,000 grams. The weight of the shells, though of course greater for the larger nuts, does not run exactly parallel to the weight of husked nuts. In general, as would be expected on mathematical grounds, the weight of the shell forms a smaller proportion of the total weight of husked nut in the case of the larger varieties. Thus, H. S. Walker (1906)[36] gave for San Ramon nuts an average of 20 per cent. for the ratio of shell weight to husked nut weight; for average Ceylon nuts the figure is about

TABLE I

Annual Production of Coconuts (Estimated)

Country	Area Planted (Acres)	% of World Total Acreage	No. of Trees (1000's)	Trees per Acre	Bearing Trees (1000's)	Annual Production of nuts (1000's)	Nuts per bearing tree per yr.	Nuts per Acre per year
Netherlands Indies ..	2,943,700	30·6	169,159	57	152,243	6,000,000	39	2038
Philippines ..	1,571,500	16·3	120,696	77	90,360	4,299,000	48	2736
India ..	1,475,900	15·3	83,917	57	78,815	3,032,600	38	2055
Ceylon ..	1,100,000	11·4	60,500	55	51,425	1,853 200	36	1685
Malaya ..	609,200	6·3	24,357	40	24,039	1,309,100	54	2149
New Guinea ..	296,000	3·1	14,372	49	11,538	438,500	38	1480
Others ..	1,622,300	17·0	84,863	52	62,245	2,598,300	42	1602
	9,618,300	100·0	557,864	58	470,665	19,530,700	42	2030

The estimates in Table I attempt to include locally consumed products, and so are considerably higher than those of Snodgrass (1928)[34] or of the International Institute of Agriculture

25 per cent., and for dwarf nuts it may reach 35 per cent. This general rule is not a rigid one, since varietal differences in shell thickness occur. For example the Ceylon "Bodiri" type of nut has a very thin shell, and the "Porapol" type, similar in size, has a very thick one. However, within a population drawn from one variety the general rule has some application, as will be seen in the fuller discussion below.

* It should be noted that in the whole of this discussion, unless otherwise stated, the reference is to ripe nuts stored in the field one month before husking, as usual in Ceylon estate practice.

Apart from varietal differences, the size of nuts is affected by soil conditions, elevation and climate. In discussing these factors, it is for two reasons convenient to confine attention to the medium-sized nuts of the tall palms widely grown in Ceylon; these are the economic type most commonly grown; and for them more accurate information is available than for other types.

It was shown by Cooke (1934)[37] that there is a high correlation between weight of husked nut and wet meat. Pieris (1935)[38] extended this to copra; very high correlations were demonstrated between weight of husked nuts and of copra therefrom and Pieris concluded that for purposes of field experimentation 32 per cent. could be taken as the ratio between weight of copra and of husked nuts.* It must be noted, however, that this figure is only applicable to nuts from tall Ceylon palms growing under normal soil and climatic conditions; Pieris' work covered a range of husked nut weight of 650 to 950 grams. H. S. Walker's figures (*loc. cit.*) show that the ratio is much lower for the large San Ramon nuts, and later unpublished observations of Pieris (1943) that it may reach 40 per cent. for dwarf nuts. Child and Salgado (unpublished observations, 1944) have further shown that, even within the same population, the copra/husked nut ratio is higher for the smaller nuts, *i.e.*, that it follows the same general rule as the shell/husked nut ratio, although the range is not quite so wide; their data is summarised below. Within the "normal" range covered by Pieris' original work, the 32 per cent. copra ratio is sufficiently accurate for practical purposes, and similarly a ratio of 25 per cent. for the shell/husked nut ratio is a sufficiently close approximation [*cf.* Child, (1940)].[40]

Drought markedly affects nut size, and Park (1934)[39] has published figures showing that the yield of copra per thousand nuts markedly declines for about a year after severe drought with a maximum effect about six months after the drought; he quotes records from an estate near Puttalam, Ceylon, where the average outturn was roughly 500 lbs. copra and where after a severe drought in 1931 nuts picked in February-March 1932, gave only 325 lbs. copra per 1,000 nuts. Nut size and corresponding copra outturn are adversely affected, though less markedly than by drought, by inferior soil conditions and are to some extent improved by adequate manuring.

Child and Salgado (see above) have examined the figures for 54 lots of nuts from the plots of a manurial experiment, in all 5,023 nuts. When these were grouped according to husked nut weight into nine lots of six plots each, the following results were obtained (Table II *a*). The only notable effect of manuring was the increase in nut size produced by application of potash fertilizers, though there is some evidence that excessive applications of nitrogen *reduce* nut size.

Table II(*a*) may be translated into practical terms. It is usual to estimate the commercial value of nuts by the number required to yield a standard weight of copra, *e.g.*, in Ceylon nuts per candy of 560 lbs., in Malaya per picul of

TABLE II(*a*)

No. of Nuts	Average Wt. Husked Nut. Grams	Average Wt. of Copra per nut Grams	Average Wt. Shell per nut Grams.*	Copra Wt. % Husked Nut Wt.	Shell Wt. % Husked Nut Wt.
404	534	190	157	35·5	29·4
463	607	207	164	34·0	27·0
387	650	220	169	33·8	26·0
595	680	222	173	32·7	25·4
662	704	226	177	32·2	25·1
624	730	241	180	33·0	24·6
665	767	247	190	32·1	24·8
570	817	259	200	31·7	24·5
653	857	269	208	31·4	24·3
General 5023 Average	719	234	182	32·6	25·3

133$^1/_2$ lbs., and in general statistics per long ton of 2,240 lbs. Similarly, in Ceylon at least, shells are valued on the number of whole-shells to a ton. Extrapolation of the data in Table II(*a*) gives the following:—

TABLE II(*b*)

Nuts to give of Copra :-			Wt. of 1,000 Husked Nuts in Lbs.	Wt. of 1,000 Whole Shells in Lbs.*	No. of Whole Shells to a Ton
1 Picul	1 Candy	1 Ton			
225	950	3800	1880	456	4910
240	1000	4000	1760	432	5190
250	1050	4200	1625	409	5480
260	1100	4400	1530	387	5790
275	1150	4600	1440	373	6000
285	1200	4800	1375	365	6140
300	1250	5000	1305	358	6260
310	1300	5200	1235	351	6380
320	1350	5400	1165	344	6510
335	1400	5600	1125	340	6590

WORLD AVAILABILITY OF COCONUT SHELLS

In computing world statistics it has been customary to take 5,000 nuts as representing a long ton of copra (*cf.* Child[32]). It is convenient to take a corresponding approximate figure of 6,000 shells to a ton in estimating production of these. On this basis the following estimates may be made of production of coconut shells in the six major producing countries:

* The weights given are all of shells from copra-drying kilns; they are thus in a drier condition than if (as in desiccated coconut manufacture) the shells are chipped off from the nut before drying. Figures for such fresh chipped shells from nuts of out-turn 1,100 candy have given 27–28 per cent. for the shell/husked nut ratio against 25 per cent. for dry shells. The lower figure is preferred for the practical table as most shells will come from copra drying.

TABLE III

Annual Production of Coconut Shells (Estimated)

	Tons
Netherlands Indies	1,000,000
Philippines	700,000
India	500,000
Ceylon	300,000
Malaya	220,000
New Guinea	73,000
	2,793,000

This production of nearly three million tons annually is, of course, negligible in comparison with that of such raw materials as coal or timber, and a sense of this proportion must be maintained in any consideration of the scope of coconut shells as an industrial raw material. In each country, too, the utilization of shells will depend not only upon production but upon availability and concentration of supplies. A large proportion of production in Malaya and New Guinea is from comparatively large well-managed plantations, whilst in India small-holdings account for most of the coconuts; collection of shells in bulk would, therefore, be easier in the former. Again in Ceylon there exist, more than in the other countries, considerable factories (oil-milling and desiccating) which handle nuts in quantity and where in consequence shells are already collected. These factors must all be taken into account—together with such forms of utilization as already exist (*e.g.*, for copra drying—see Ref. 31).

31. Child, R., "Coconut Shells as an Industrial Raw Material. II. Miscellaneous Uses. Fuel", *Curr. Sci.*, 1944, **13**, 4–6. See this article for references 17–30, and the previous article (ref. 17. *Curr. Sci.*, 1943, **12**, 292–294), for references 1–16. 32. Child, R., "Ceylon's Coconut Crops", *Tropical Agriculturist* (*Ceylon*), 1939, **92**, 330–335. 33. *Review of Coconut Products for 1938*. Leo Schnurmacher, Inc., Manila, Commonwealth of the Philippines, 1939. 22. Table N. 34. Katharine Snodgrass, "*Copra and Coconut Oil*", *Fats and Oils Studies*, No. 2, Food Research Institute, Stanford University, California, April, 1928, Chapter III, 26–34. 35. International Institute of Agriculture. *Studies of Principal Agricultural Products on the World Market*, No. 4. *Oils and Fats: Production and International Trade*—Part I, (Rome, 1939), 165–199. 36. Herbert S. Walker., "The Coconut and its Relation to the Production of Coconut Oil", *Philippine J. Sci.*, 1906, **1**, 58–82. 37. Cooke, F.C., "The Relationship between Weights of Coconuts, Husked Nuts and Meat," *Malayan Agric. J.*, 1934, **22**, 539–40. 38. Pieris, W. V. D., "Studies on the Coconut Palm—II. On the Relation between the Weight of Husked Nuts and the Weight of Copra," *Tropical Agriculturist* (*Ceylon*), 1935, **85**, 208–20. 39. Park, M., "Some Notes on the Effect of Drought on the Yield of Coconut Palms", *Ibid.*, 1934, **83**, 141–150. 40. Child, R., "Coconut Shell Charcoal", *Coconut Research Scheme* (*Ceylon*) *Leaflet No. 6*, March 1940, pp. vii & 1 diagram. Reprinted in *Journal of Coconut Industries* (*Ceylon*), 1940, **4**, No. 2 (June), pp. 77–84, in *Travancore Economic Journal*, 1940, **19**, 573–78, and in *New Guinea Agricultural Gazette*, 1941, **7**, 61–65.

SIMILARITIES BETWEEN THE EXCITATION PHENOMENA IN UNSTRIATED MUSCLE AND THOSE IN THE RETINA

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THERE is a close resemblance between the excitation phenomena in unstriated muscle, and those in the retina; the resemblance may be superficial, but there is probably an underlying unity between excitation processes in tissues, which are physiologically widely divergent. The excitation phenomena in the retina described herein, are summarised from Hartridge (1941).

In unstriated muscle, there are two antagonistic excitabilities (Singh, 1938); there appear to be similar antagonistic excitabilities in the retina. This antagonism in the retinal response may be in the individual rods and cones, or in groups of rods and cones or may be in the nervous elements higher above. In unstriated muscle, these antagonistic excitabilities appear to be located in the individual muscle fibres, and it is quite possible, that in the retina, they are located in the individual cones and rods.

Adaptation and Fatigue.—In plain muscle, these two phenomena are identical. If the eye, after being in the dark, is rapidly exposed to light, it becomes light adapted. *Mytilus* muscle and frog stomach similarly become adapted to alternating current. In the eye fatigue to one colour, results in hyper-excitability to the complementary colour. In plain muscle too, adaptation and fatigue of one excitability results in hypersensitiveness to the antagonistic excitability; in *Mytilus* muscle, adaptation and fatigue to alternating current, results in hyper-excitability to potassium (Singh, 1944).

The After-Image and the A.C. Off-Contracture.—As a result of a stimulus the region of the retina affected gives a response which is followed by a second or after-image. During the after-image, the area is incapable of reacting with normal intensity to a like stimulus, but shows increased excitability to a stimulus of the opposite kind.

A corresponding phenomenon is seen in unstriated muscle. A contraction produced by alternating current or by increase in the osmotic pressure of the saline, is followed by an antagonistic contraction on cessation of the stimulus. On cessation of the current, the muscle is less responsive to it, but hyperexcitable to potassium, i.e., excitable to the same stimulus, but hyperexcitable to stimulus of the opposite kind.

The after-image of the first impression is removed by the second impression. Similarly the A.C. off-contracture is neutralised by a second stimulation with alternating current.

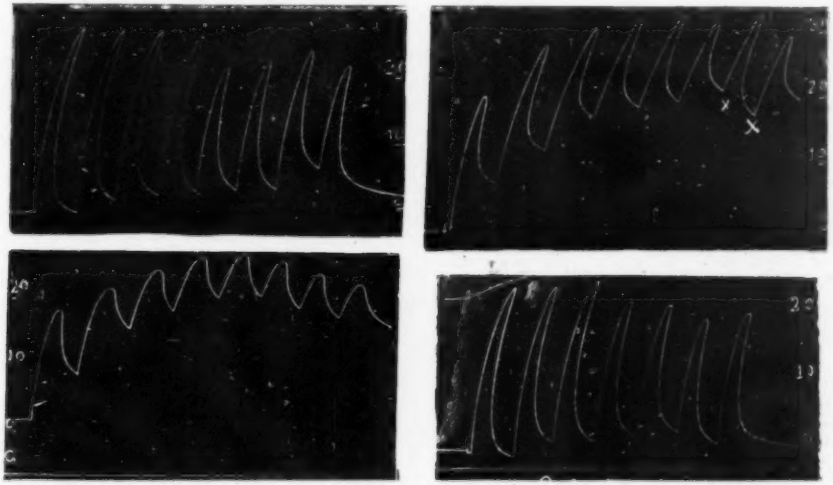
The duration of the after-image is found to correspond roughly with the intensity and duration of the stimulus; the magnitude of the A.C. off-contracture also corresponds with the intensity and duration of the alternating current.

Successive Contrast.—In the eye, after stimulation by one kind of source, another of a similar nature is inhibited, while that of a different nature is either unaffected or may be even increased. These results are very similar to those described in unstriated muscle. After stimulation with alternating current, the excitability to the current is depressed, and that to potassium may remain unaltered or may even be increased.

Simultaneous Contrast.—This appears to be due to extension of the after-image phenomenon into a region of retina outside the confines of the original stimulus. It would appear as if some substance is liberated in the stimulated area which diffuses into the neighbouring parts. This suggestion is very similar to the stimuli is required to produce fusion as high intensities than at low.

In plain muscle, the fusion is more complete if the successive stimuli are of low intensity or shorter duration (Fig. 1, l.). In *Mytilus* muscle a stimulus of very high intensity may act like a stimulus of low intensity. This is due to the fact that for stimulation, the muscle possesses an optimum voltage, so that high voltages become submaximal stimuli.

Plain muscle shows other phenomena of excitability shown by nerve structures. Thus the statement that a stimulus has two components, one excitatory and the other inhibitory (Singh, 1943), is analogous to the statement that in the nerve cells there are two antagonistic states, such as the central excitatory state and the central inhibitory state; the latter is identical with adaptation in unstriated muscle. The phenomenon of "rebound" after inhibition is well shown by plain muscle; those similar to subliminal fringe and occlusion are also found.



On the left; 1st fig. Stimulation of *Mytilus* muscle with A.C. 10V/10 sec. per min. 2nd fig. with A.C 5V/10 sec. per min.
On the right: 1st fig. A.C. 10V/3 sec. per min. 2nd fig. A.C. 10V/12 sec. per min.

one I have made regarding the A.C. off-contracture in plain muscle. The substance producing the contracture appears to diffuse away from the seat of action into the solution; in plain muscle, this substance may be potassium, and it is possible that potassium leaks from the stimulated cones into the surrounding areas. There is increased leakage of potassium from *Maia* Nerve during stimulation (Cowan, 1934), and corresponding gain of sodium by *Mytilus* muscle (Singh, 1939).

Flicker and Visual Persistence.—The persistence of the primary image after the cessation of the stimulus causes the stimuli to fuse to give a uniform sensation without flicker, which may be compared to complete tetanus of a muscle. In the eye, since the primary response is more abrupt, the greater the intensity of the stimulus, a more rapid rate of succession of

Discussion.—It would appear that the mechanisms of stimulation of the retina and plain muscle are very similar. It would then be legitimate to expect that there may be other analogies between the functioning of the two besides those given above. If cones like plain muscle have two antagonistic excitabilities, then they are stimulated by complementary colours. Like plain muscle some cones may be less excitable to both forms of stimulation, resulting in the cone mechanism being inactive, or the inexcitability may extend to certain parts of the spectrum, resulting in some form of colour blindness.

1. Cowan, S. L., *Proc. R. Soc.* B, 1934, **115**, 216. 2. Hartridge, H., *Starling's Principles of Human Physiology*, 1941, London. 3. Singh, I., *J. Physiol.*, 1938, **92**, 62; 1939, **96**, 1; *Proc. Ind. Acad. Sci.*, 1943, **17**, 20; 1944, **19**, 91.

LETTERS TO THE EDITOR

	Page
On Linear Estimation and Testing of Hypothesis. By C. Radhakrishna Rao	154
Activation of Nitrogen at Liquid Air Temperature. By S. S. Joshi and A. Purushotham	155
A Short Note on the Infra Traps of Kotah State. By V. S. Dubey and Y. K. Agrawal	155
X-Ray Topographs of Diamond. By G. N. Ramachandran	156
Rupture of Water Drops Falling on Liquid Surfaces. By B. N. Singh and S. P. Sinha	157
Ethyl Alcohol as a Solvent for Modified Romonowsky Stains. By B. S. Roy	157
Rearrangement of Santenone-Quinone. By Ram Narayan Chakravarti	158
The Occurrence and Inheritance of a New Type of Hairiness in Asiatic Cottons. By K. Ramiah and V. N. Paranjpe	158
Studies on the Physiology of Mustard. By J. C. Sen Gupta and Nirad Kumar Sen	160
Trichodina *sp. from the Capsular Gland of* Ariophanta ligulata *(Fer.).* By P. N. Rajakrishna Menon	161
Burnt Paddy-Husk for the Control of Insects in Stored Food Grains. By M. J. Narasimhan and B. Krishna Murthy	162
Relief for Science Teachers. By S. S. Bhatnagar	162

ON LINEAR ESTIMATION AND TESTING OF HYPOTHESIS

1. The object of the present note is to consider the most general problem in the theory of linear estimation and get suitable generalisations of Markoff's theorem and to derive suitable tests of significance connected with estimated functions.

2. There are n stochastic variates $T_1, T_2, \ldots T_n$ with the variance and covariance matrix $\Lambda = ((\lambda_{ij}))$ such that

$$E(T_i) = \theta_i = a_{i1}\tau_1 + a_{i2}\tau_2 + \ldots + a_{im}\tau_m \quad (2{\cdot}1)$$

and m not necessarily less than n. Some of the τ's may be regression constants in which case their coefficients will be functions of concomitant variates. We want a linear function $L(T) = b_1T_1 + b_2T_2 + \ldots + b_nT_n$ such that $E\{L(T)\} = \theta = l_1\tau_1 + l_2\tau_2 + \ldots + l_m\tau_m$, a given parametric function and $V\{L(T)\}$ is minimum. If $L(T)$ can be found to possess such properties then it is called the best estimate of θ.

3. It has been shown that the set of equations

$$Q_i = L_i\Lambda^{-1}y' = \sum_{j=1}^{m} L_i\Lambda^{-1}L_j'\tau_i = h_i \quad (3{\cdot}1)$$

$(i = 1, 2, \ldots m)$, where L_i and y are the row matrices $(a_{1i}, a_{2i}, \ldots a_{ni})$ and $(T_1, T_2, \ldots T_n)$ and the dash represents their transpose obtained by minimising

$$L = \Sigma\Sigma\,\lambda^{ij}(T_i - \theta_i)(T_j - \theta_j), \quad (3{\cdot}2)$$

where λ^{ij} are the elements of Λ^{-1}, are such that Q_i is the best estimate of h_i and the best estimate of θ is given by $\Sigma\, c_iQ_i$ where c's are such that $\theta \equiv \Sigma\, c_ih_i$. If the rank of the matrix of the equations (3·1) is less than m, then all parametric functions are not estimable

4. The set of equations (3·1) possesses the following properties.

(i) Variance of Q_i is the coefficient of τ in the ith equation;

(ii) Covariance of Q_i and Q_j is the coefficient of τ_j in the ith equation;

(iii) If $\Sigma\, c_iQ_i \equiv 0$, then the parametric function $\Sigma\, c_i\tau_i$ is not estimable;

(iv) If $\Sigma\, a_iQ_i$ and $\Sigma\, b_iQ_i$ are the estimates of $\Sigma\, l_i\tau_i$ and $\Sigma\, m_i\tau_i$, then their variances and covariances are given by

$$\begin{pmatrix} \Sigma\, al & \Sigma\, bl \\ \Sigma\, am & \Sigma\, bm \end{pmatrix}$$

(v) The number of estimable parametric functions is equal to the number of functionally independent Q's.

(vi) An intrinsic property is that all the above five properties hold good even with a subset of the equations obtained by eliminating one or more τ's.

(vii) The best estimate of any estimable parametric function $\Sigma\, l\tau$ is unique and is obtained by substituting any particular solution for τ's obtained by solving the equations (3·1) or any set of equations derived from it; and so also the expressions for the variances and covariances.

5. If we want to test the hypothesis $\Sigma\, l\tau = \xi$ then we construct the statistic

$$w = \frac{\Sigma\, cQ - \xi}{\sqrt{\Sigma\, cl}},$$

where $\Sigma\, cQ$ is the estimate of $\Sigma\, l\tau$ and refer the normal tables for tests of significance. If we want to test the composite hypothesis $\Theta_i = \Sigma\, l_{ij}\tau_j = \xi_i, i = 1, 2, \ldots k$ we take a linear compound of these k relations

$$\Sigma\, \lambda_i(\Theta_i - \xi_i)$$

with the corresponding estimate

$$\Sigma\, \lambda_i(\Sigma\, c_{ij}Q_j - \xi_i) = \Sigma\, \lambda_iP_i$$

and variance $\Sigma\Sigma \lambda_i \lambda_j V_{ij}$ where $V_{ij} = \text{cov}(P_i P_j)$ and construct the above statistic

$$V = \frac{\Sigma \lambda_i P_i}{\sqrt{\Sigma\Sigma \lambda_i \lambda_j V_{ij}}}.$$

We choose the compounding coefficients such that V^2 is maximun. This leads to the determinental equation

$$|P_i P_j - V^2 V_{ij}| = 0.$$

The distribution of V^2 on the non-null hypothesis is obtained as

$$\text{Const} \cdot e^{-\frac{V^2}{2}} (V^2)^{\frac{k-1}{2}} I_{\frac{k}{2}} (V\phi)\, d V^2.$$

on the assumption that the y's form a multivariate normal system. The necessary statistics, when the variances and co-variances are not known are obtained by studentising the above statistics. Some of the important distributions will be discussed in a paper to be published in full elsewhere.

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April 4th, 1944.

ACTIVATION OF NITROGEN AT LIQUID AIR TEMPERATURE

THE behaviour of active nitrogen is remarkable towards heat. The disappearance of its after-glow on heating, first noticed by Lord Rayleigh[1] has been found by us to be subject to the pressure conditions of the activated gas:[2] the quenching temperature is increased by an increase of the gas pressure.[2] Rayleigh also observed that if a stream of active nitrogen is led through a tube cooled by liquid air, the after-glow is quenched.[1] Our recent results show that the occurrence of this quenching also depends upon the magnitude of the gas pressure; when this last was raised above 40 mm., the glowing nitrogen escaped the *Rayleigh quenching* produced, at say 15 mm. under the same conditions.

Attempts were next made to minimise a possible insufficiency in the cooling of the gas at high pressures. The nitrogen was streamed through spirals, in all about 3 yards long, cooled by liquid air. The last spiral surrounded the Crooke's tube used for the nitrogen activation by electrical discharge. With the discharge tube under liquid air, it was remarkable to observe that the Rayleigh quenching of the nitrogen after-glow did not occur, at even such small pressures of about 1 mm., at which, under normal conditions, it was easily produced.

An interesting result was now observed when the gas pressure was reduced beyond 0·1 mm. An after-glow of 15-17 minutes' duration was produced; platinum and aluminium electrodes were used. Starting with fresh electrodes, both the intensity and duration of the after-glow increased markedly with repeated discharges. Results were in essence the same with pure nitrogen and with an admixture of 0·8 per cent. of oxygen, except for the fact that with the latter a greater number of discharges were necessary than with pure nitrogen, to produce this long after-glow; it was not observed if the gas pressure was reduced to that due to a Topler. This long after-glow could not be ascribed to activated vapour of mercury or that of the pump oil, since there were liquid air traps on either side of the discharge tube. Observations with a direct vision spectroscope showed that this long after-glow was a nitrogen emission; besides, it was not observed when the nitrogen was replaced by air, hydrogen or carbon dioxide, other conditions being unaltered. Cooling by liquid air during activation is more favourable than an elaborate pre-cooling before exposure to discharge, for the production of this long after-glow. That on the cessation of the discharge and after allowing the temperature of the system to rise, there ensues a sensible rise of pressure, suggests that a 'clean up' or adsorption of the nitrogen on the electrodes is a possible factor in the occurrence of this phenomenon.

Chemistry Department,
Benares Hindu University, S. S. JOSHI.
May 10, 1944. A. PURUSHOTHAM.

1. Strutt, R. J., *Proc. Roy. Soc.*, 1911, **A 85**, 219–29.
2. Joshi and Purushotham, *Proc. Ind. Acad. Sci.*, 1944, **A 19**, 159–62.

A SHORT NOTE ON THE INFRA TRAPS OF KOTAH STATE

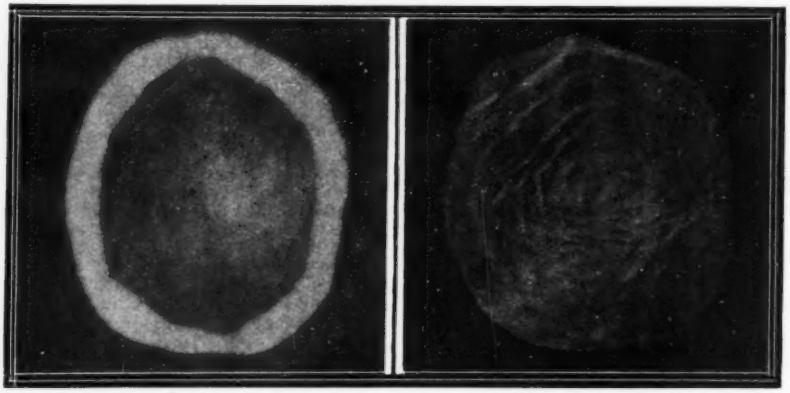
RECENTLY the writers had been to Kotah State in connection with the mineral survey of the State. There they studied a formation which has been referred to and mapped as Infra Trap in the old G.S.I. map. This lies over the Vindhyans and is below the trap. Its thickness is much variable being from a few feet to about 100 feet. The formation consists of a hard cherty silicious rock probably formed by the deposition of the volcanic ash in the lakes existing at that time. It appears that the rocks of this formation were deposited just before the outpouring of the lava. In this formation the authors have found fossils, both animal and plant. The animal fossil probably seems to be the jaw of some reptilian group and the plant fossil showing sporo-carps, spores, etc., are probably of the Marsiliaceæ group. As far as the authors are aware this is the first locality where the fossils have been found just below the trap in Rajputana. The fauna and flora revealed are quite interesting. Detailed work is going on and the results will be published later.

Benares Hindu University, V. S. DUBEY.
April 27, 1944. Y. K. AGRAWAL.

X-RAY TOPOGRAPHS OF DIAMOND

IN a recent paper[1] published by the Indian Academy of Sciences, and included in a Symposium on the Structure and Properties of Diamond, the author described a method by which any variations in the reflecting power of the lattice planes for X-rays which may exist over the area of a cleavage plate of diamond may be rendered evident. The technique employed is based on the use of white X-radiation diverging from a pinhole, and thus giving a Laue reflection at a chosen set of lattice planes. By suitably tilting the crystal and the photographic film, a practically undistorted reproduction, or "X-ray topograph" of the crystal can be obtained. Some 18 topographs of this kind were reproduced in the paper. Unfortunately, however, in obtaining these, duplitized X-ray films were employed with the result that there was a certain amount of blurring, and much of the detail was lost. It has since been found that greatly improved results are obtained by using photographic plates instead of films.

The remarkable relationship that exists between the X-ray topographs and the other patterns, such as the luminescence, the birefringence and the ultra-violet transparency patterns are best appreciated only when they are set side by side, with all the pictures enlarged to the same size, and arranged in the



Luminescence Pattern X-Ray Topograph

FIG. 1. Luminescence Pattern and X-Ray Topograph of D 188

Birefringence Pattern X-Ray Topograph

FIG. 2. Birefringence Pattern and X-Ray Topograph of D 181

same orientation. Since this is scarcely possible in the publication quoted above, two typical topographs of diamonds D188 and D181 are reproduced in Figs. 1 and 2 above, together with the corresponding luminescence pattern of the former, and the birefringence pattern of the latter, which were taken by Mr. G. R. Rendall. The topograph of D188 was taken with the new technique, and shows fine detail. A comparison of these patterns reveals the remarkable similarity that exists between them.

Department of Physics,
Indian Institute of Science,
Bangalore, G. N. RAMACHANDRAN.
June 14, 1944.

1. Ramachandran, G. N., *Proc. Ind. Acad. Sci.*, 1944, **A19**, 280.

RUTPURE OF WATER DROPS FALLING ON LIQUID SURFACES

THE present note contains preliminary observations on the rupture of water drops falling on liquid surfaces. Water drops of different sizes were allowed to fall from gradually increasing heights upon an oil surface. Observations show that for a given oil and for a given size of water drops, rupture takes place only when the drops fall from heights greater than a critical value.

An elegant method would no doubt be to study the phenomenon of rupture with the aid of high speed photography, recently developed to a considerable degree of perfection by H. E. Edgerton. In the absence of such a technique in this laboratory, only visual observations were made.

In the present investigation, kerosene, transformer oil and olive oil were employed. It was found that in the case of each oil mgh was nearly found to be constant, where m is the mass of the drop, g the acceleration due to gravity and h the critical height. The kinetic energy with which the drop should fall on the oil surface, in order that rupture may take place, should be greater than a critical value. This critical energy for a given drop varies with the nature of the oil and is probably connected with its surface tension and viscosity.

The critical energies for a drop of mass 0·825 gm. when falling upon kerosene, transformer oil and olive oil were found to be 240, 260 and 320 ergs respectively. The greater the viscosity of the oil, the larger is the value of the critical energy.

Further work is in progress and it is hoped to determine exactly the factors controlling the rupture of the drops.

Physics Laboratory,
Science College,
Patna, B. N. SINGH.
S. P. SINHA.
April 14, 1944.

1. *Flash*, by Edgerton and J. R. Killian (Hale Cushman and Flint, Boston), 1939.

ETHYL ALCOHOL AS A SOLVENT FOR MODIFIED ROMANOWSKY STAINS

THE first worker to make use of a solvent other than water for dissolving the precipitate of compound stain produced by mixing methylene blue with eosin was Jenner (1899) who used methyl alcohol for this purpose. But since he did not use polychrome methylene blue for the preparation of his stain powder, therefore, his stain lacked the nuclear staining principle of Nocht's (1898) modified Romanowsky stain. Combining of Jenner's technique with Nocht's was taken up independently by Reuter (1901) and Leishman (1901). Reuter used absolute ethyl alcohol with aniline oil as the solvent whereas Leishman used the original methyl alcohol (Merck's "for analysis") of Jenner. But since in case of Reuter's technique a separate process of film fixation was always necessary, therefore his method did not become popular with people who preferred Leishman's method of fixing and staining in a single operation.

Since that date, all blood stains are, in general, modifications of the original Leishman's stain. Some of them, like Wright's and Wilson's stains, differing only in detail, whereas others, like Giemsa's and MacNeal's tetrachrome stains, are slightly different in composition. The solvent used for the preparation of solutions from these stains is, however, the same methyl alcohol as was originally used by Jenner or Leishman.

The difficulty in obtaining supplies of neutral acetone-free absolute methyl alcohol at reasonable prices for the preparation of blood stains led us to try experiments with a view to find out if absolute ethyl alcohol could be used in place of the expensive acetone-free methyl alcohol. As a result of these experiments we have seen that absolute ethyl alcohol can be safely substituted for the expensive methyl alcohol in the preparation of Leishman and Giemsa solutions. Ethyl alcohol, in fact, was found to possess a marked advantage over methyl alcohol when staining was to be done at higher atmospheric temperatures. Methyl alcohol being more volatile always gave a deposit of the stain on the film, but preparations with ethyl alcohol were free from this defect.

Various solutions of Leishman and Giemsa stains prepared with absolute ethyl alcohol were repeatedly tested for the staining of malarial blood. The technique followed being identical with the original formulæ of Leishman and Giemsa. In no case preparations inferior to those obtained with solutions containing methyl alcohol were obtained. In case of Giemsa solution, where fixation of thin smears is done separately and that of thick smears is unnecessary, the ordinary lime-distilled rectified spirit gave excellent results.

In view of the above results we are inclined to believe that:—

(1) The use of expensive acetone-free methyl alcohol for the preparation of blood stains as specified in literature is only incidental and not very necessary.

(2) Absolute ethyl alcohol can be a good substitute for the expensive acetone-free methyl alcohol in the preparation of stain solutions required for simultaneous fixation and staining of blood films.

(3) Even 95 per cent. alcohol can be used in the preparation of solutions of Giemsa type where fixation of thin smears is done separately and that of thick smears is unnecessary.

(4) Ethyl alcohol, in the preparation of Leishman type solutions for staining at higher atmospheric temperatures, is definitely superior in use to the volatile methyl alcohol.

My best thanks are due to Prof. J. N. Ray, Director of Drugs and Dressings, for his kind interest in the work.

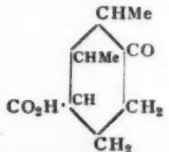
Central Research Institute,
Kasauli, and
Drugs & Dressings Directorate,
Directorate-General of Supply, B. S. ROY.
New Delhi,
April, 24, 1944.

1. Jenner, L., *Lancet*, **1899**, Pt. I, 370. 2. Leishman, *Brit. Med. J.*, **1901**, Pt. II, 757. 3. Nocht, *Centbl. f. Bakt., I. Abt.*, **1898**, **24**, 839. 4. Reuter, *Ibid.*, **1901**, **30**, 249.

REARRANGEMENT OF SANTENONE-QUINONE

SAMUEL AND MANASSE[1] found that camphorquinone on treatment with concentrated sulphuric acid undergoes molecular rearrangement to give a keto-acid, $C_{10}H_{16}O_3$, which has been definitely shown by Simonsen and his coworkers,[2] to be 2:2:3-trimethylcyclohexan-1-one-4-carboxylic acid. It has now been found that *dl*-santenonequinone[3,4] (prepared by the oxidation of santenone with selenium dioxide), under precisely similar conditions, furnishes 2:3-*dimethylcyclohexan*-1-*one*-4-*carboxylic acid* (I), m.p. 132° (*semicarbazone*, m.p. 191°). The structure of the ketonic acid has been proved by degradation and by synthesis.

In the first instance, it has been found that this keto-acid on oxidation with nitric acid furnishes a tribasic acid, m.p. 181-82°, identical with a sample of *α-methylbutane-αβδ-tricarboxylic acid* (II), prepared by the condensation of ethyl β-chloropropionate with ethyl α-cyano-β-methylsuccinate[5] in presence of sodium ethoxide followed by hydrolysis of the resulting product. The formation of an acid of structure (II) by oxidation can readily be explained on the basis of structure (I) for the keto-acid.



(I)

$CO_2H{\cdot}CHMe{\cdot}CH(CO_2H)CH_2{\cdot}CH_2{\cdot}CO_2H$

(II)

The keto-acid itself has been synthesised by a simple and unambiguous method as follows: Ethyl αβ-dimethylacrylate has been condensed with ethyl cyanoacetate in presence of sodium ethoxide in the usual manner. The resulting sodio-salt reacts quantitatively with ethyl-β-chloropropionate to give ethyl γ-cyano-αβ-dimethyl*pentane-αγε-tricarboxylate*, b.p. 200-204°/6 mm., which on hydrolysis and subsequent esterification furnishes *ethyl αβ-dimethylpentane-αγε-tricarboxylate*, b.p. 178°/7 mm. The triethyl ester on cyclisation with finely divided sodium yields *ethyl* 2:3-*dimethylcyclohexan*-1-*one*-4:6-*dicarboxylate*, b.p. 170°/8 mm. 2:3-*Dimethylcyclo-hexan*-1-*one*-4-*carboxylic acid* (I), m.p. 132° (semicarbazone, m.p. 191°) as obtained by hydrolysis of the above ketonic ester has been found to be identical with the ketonic acid formed by the rearrangement of santenonequinone.

My grateful thanks are due to Dr. J. C. Bardhan for the facilities offered to me and for his kind advice and criticism.

University College of
Science and Technology,
Calcutta, RAM NARAYAN CHAKRAVARTI.
March 20, 1944.

1. *Ber.*, **1897**, **30**, 3157; **1902**, **35**, 3831. 2. Gibson and Simonsen, *J. Chem. Soc.*, **1925**, **127**, 1295; Bhagavat and Simonsen, *Ibid.*, **1927**, **131**, 77. 3. Semmler and Bartelt, *Ber.*, **41**, 125. 4. Palmén, *Finska Kemistamfundets Medd.*, **36**, 11-21. 5. Bone and Sprankling, *J. Chem. Soc.*, **1899**, **75**, 853.

THE OCCURRENCE AND INHERITANCE OF A NEW TYPE OF HAIRINESS IN ASIATIC COTTONS

APART from the degree of hairiness ranging from glabrous to a densely hairy plant-body, there is variation in the type of hairs on the cotton plant. Youngman and Pande[1] in their study of the epidermal outgrowths in the genera *Thespesia* and *Gossypium* describe two types of hairs, (i) the single hair-unicellular outgrowths and (ii) the stellate hair which originates from tufts of several cells fused at their bases.

A microscopical examination of hairiness in a large number of cotton types both *arboreum* and *herbaceum* at Indore has shown that both the types of hair, single and stellate, are present in all the types but while the single hair

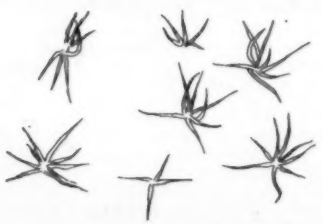


FIG. 1

is distributed all over the plant-body the stellate hair is mostly confined to the foliar organs, leaves, bractioles and petals. The number of rays in the stellate hair varies from 2 to 12, the most common number being 8 for *arboreums* and 6 for the *herbaceums* (Fig. 1). The length of the hair is generally found to be longer in the *herbaceum* than in the *arboreum*. In *G. tomentosum* which has a characteristic dense hairiness, the effect of gene H^{to}, Harland,[2] the hairs are all stellate with 8 rays interspersed occasionally with stellate hairs of larger number of rays in addition to single hairs to be found mainly on the leaf veins.

A new type of stellate hair (Fig. 2) has now been discovered in a *herbaceum* mutant, Viramgam lintless, where the stellate hair has

FIG. 2

20-30 short rays as against 2-12 found in other types. The distribution of this type of stellate hair over the plant-body is the same as in the ordinary stellate type. This hair gives the plant organs a characteristic waxy appearance. The leaves have a gritty feel and on rubbing with the fingers the grit comes off easily. This type of hairiness has so far not been met with in any other cotton. It may be mentioned here that this stellate hair does not

FIG. 3

correspond to the peltate scale of *Thespesia* described by Youngman. Whereas the rays of the stellate hair are free almost to four-fifths of their length, in *Thespesia* the rays are fused almost the whole length with the ends only free.

Evidence is here presented to show that this new type of stellate hair is due to a single gene designated H^{vi} and it is recessive to the normal hair and that this gene is independent of the lintless gene *lid* (Govande)[3] of Viramgam lintless in its inheritance.

This new type had been crossed with three other types mentioned below mainly for studying the inheritance of lintlessness and incidentally the behaviour of the stellate hair was recorded in the F_1's and F_2's.

Types	*Species*
1. Wagad lintless	*G. herbaceum* var. *frutescens*
2. Nandyal lintless	*G. arboreum* var. *typicum* forma *indica*
and 3. N_6.	A synthetic multiple recessive

The F_1's, ratoons of last year (the observation was not made in the first crop) do not show any marked difference from the normal except that they appear a little more pubescent than the parents. Examination of the leaves under the microscope showed the normal stellate hairs with 6-8 rays somewhat longer than in the Viramgam lintless parent with occasional hairs having 12-16 rays. There was clear segregation for the type of stellate hair in the F_2 even for naked eye but two leaves of each plant were examined under the microscope and scored, keeping the normal and F_1 type together as the separation between the two was rather difficult, the main difference between the two being in the number of rays.

	Segregation			
	Normal	Viramgam Stellate	Total	X^2 3:1
1. Viramgam lintless × Wagad lintless	133	69	169	1·23
2. Viramgam lintless × Nandyal lintless	101	28	129	0·75
3. Viramgam lintless × N_6.	70	15	85	2·45

The fit is not bad although in all the three crosses there is a consistent excess of the normal. There could, however, be little doubt about a single gene difference. Plants typical of the Viramgam stellate type were recovered only in the cross between the two herbaceums, Viramgam lintless × Wagad lintless, whereas in the other two crosses, interspecific, the stellate type was modified to a certain extent in that the number of rays of the stellate hair was slightly reduced, about 20 only, and the rays were also slightly longer than in the Viramgam type.

The two crosses, Viramgam lintless × Wagad lintless and Viramgam lintless × Nandyal lintless have not produced any bolls yet but the cross Viramgam lintless × N_6 has started producing bolls nine months after sowing.

Examination of the bolls in the last cross has shown that some of the plants with the Viramgam stellate hair are linted and that some of the lintless segregates have normal hairs, indicating that the lintness gene *lid* is independent of H^{vi} in its inheritance.

The work here reported was conducted as part of the Cotton Genetics Research Scheme, Indore, financed by the Indian Central Cotton Committee. We are indebted to Mr. P. D. Gadkari who made the Viramgam lintless crosses when he was at Indore.

Institute of Plant Industry,
Indore, C.I., K. RAMIAH.
May 1944. V. N. PARANJPE.

1. Youngman, W., and Pande, S. S., 'Epidermal outgrowths of the genera *Thespesia* and *Gossypium*," *Annals of Botany*, 1929, **43**, 711. 2. Harland, S. C., *Genetics of Cotton*, Jonathan Cape, 1939, 84. 3. Govande, G. K., 'A new gene for lintlessness in Asiatic cottons," *Curr. Sci.*, 1944, **13**.

STUDIES ON THE PHYSIOLOGY OF MUSTARD

A NUMBER of experiments on the fundamental aspects of the physiology of growth and development, with reference to time of flowering and fruiting of mustard plant was devised with selected varieties of the Agricultural Department, Bengal, Tori No. 7 and Rai No. 5 in pots with five replicates and twenty individuals in each case and the results are reported below.

(1) *Effect of time of sowing.*—Sowings of the two varieties at interval of 15 days commencing from 1-9-'43 to 15-11-'43 were investigated.

In Tori, the flowering time for the five sowings varied between 16 and 20 days and the time of fruiting between 24 and 28 days. There is thus no significant effect of the time of sowing on the time of flowering and fruiting, though it is evident that temperature, humidity and length of day gradually decreased as the sowing time was delayed. It was, however, found that all plants sown on 1-9-'43 and 20 per cent. of those sown on 16-9-'43 failed to set seed.

In Rai for the six sowings on 1-9-'43 and the subsequent dates the times of flowering were 46, 44, 34, 26, 27, 27 days and the times of fruiting 55, 55, 43, 40, 39 and 38 days. It is thus seen that the vegetative period gradually shortened from 46 to 27 days from the first to the fourth sowing and then remained more or less constant in the last three sowings.

(2) *Photoperiodic effect.*—To study the effect of length of day on flowering and fruiting time, two sets of experiments were devised. In the first set with the two varieties, sown on 16-9-'43 plants were exposed to 14 hours and 10 hours light period when the control were exposed to normal daylight which gradually decreased from 12 hrs. 15 mins. to 11 hrs. 26 mins. The prolongation of light period was done by exposing the plants to electric light from a 100 c.p. bulb in a chamber at a distance of 5 feet from the pots, after sunset for the additional period and the shortening was done by taking the pots in a dark chamber for the required period before sunset and then brought out. It was found that with 14 hours the flowering time was 42 days and with 10 hours 53 days against 44 days in the control for Rai and for Tori the flowering time was 20 days for 14 hours, 22 days for 10 hours and 20 days for the control. It is thus seen that in Rai the shortening of light period prolonged the vegetative phase and for Tori the effect is negligible.

The second set was therefore designed with Rai only. Sown on 15-11-'43 and the light period used were 16 hours, 14 hours, 10 hours and 8 hours as against control where the light period gradually decreased from 10 hrs. 56 mins. to 10 hrs. 36 mins. The flowering time was 24 days for 16 hours, 26 days for 14 hours, 33 days for 10 hours and 47 days for 8 hours as against 27 days in the control. Shortening the light period thus shows a lengthening of the vegetative period in this set also though the actual flowering time in light periods common to both sets was much greater in the first set.

In the experiment on photoperiodism it is found by a comparison of the two sets of experiments with Rai sown on 16-9-'43 and 15-11-'43 that in the second set the vegetative periods were shorter than those in the first set for the same light periods used. In the time of sowing experiments also the flowering time became gradually shortened with lateness of sowing, though according to the photoperiodic effect recorded for Rai, the flowering time should have become gradually longer as the daily light period gradually decreased with lateness of sowing from 12 hrs. 34 mins. to 10 hrs. 35 mins.

It is, however, seen that the temperature gradually decreases from September to December the monthly mean temperatures for September, October, November and December being 29·2° C., 28·5° C., 24·0° C. and 21·4° C. It appears, therefore, that the vegetative period shortens with lower temperature, but for the sowings on 15-10-'43, 1-11-'43 and 15-11-'43, it is more or less the same. It seems thus that 24-27 days is about the minimum vegetative period which is not further decreased either by lower temperature or by longer photoperiod under conditions of the experiment.

Thus it may be concluded that a longer vegetative period in the first set of photoperiodic experiments and a gradual decrease in flowering time in case of time of sowing experiments is due to the vegetative period being shortened with decrease of temperature. Under conditions of experiment of the two varieties studied the time of flowering in Tori seems to be practically indifferent to light period and to the time of sowing, though Rai shows a lengthening of vegetative period with the shortening of the light period and a greater shortening of the vegetative period is observed with increased temperature range and this confirms Sen and Chakrabarty's findings (1942). In the time of sowing experi-

ment the expected photoperiodic effect in Rai, due to shortening of day length is, however, seen to be counterbalanced by low temperature effect.

(3) *Vernalization*.—Soaked unsprouted seeds of both the varieties were exposed to 2-4° C. in a refrigerator for 10, 20 and 30 days and sown on 1-10-'43 with controls. The flowering time for the control, and 10, 20, 30 days vernalized sets were 34, 33, 30 and 30 days and the fruiting time 43, 38, 38, 38 days respectively for Rai and the flowering time were 18, 18, 17, 15 days and the fruiting time 26, 25, 23 and 24 days respectively for Tori. Tori thus seems to be indifferent in the flowering and fruiting time due to presowing low temperature treatment and in Rai in view of the variation between plants within each treatment the differences in flowering and fruiting time are not significant.

Sen and Chakrabarty (1942) in the course of their intensive investigations over a number of years have reported a clear earliness of flowering in mustard due to presowing low temperature treatments. The results reported here do not confirm their findings, but it should be remembered that the varieties used by them and the authors are not the same and the post-treatment environmental factors in Almora and Calcutta are distinctly different.

It is thus seen that for any conclusion arrived at, after vernalization studies, the variety and the post-treatment environmental conditions should always be taken into account.

Botany Department,
Presidency College,
Calcutta,
May 6, 1944.

J. C. Sen Gupta.
Nirad Kumar Sen.

1. Sen, B., and Chakrabarty, S. C., *Ind. Jour. Agr. Sci.*, 1938. 2. —, *Ibid.*, 1942.

TRICHODINA SP. FROM THE CAPSULAR GLAND OF *ARIOPHANTA LIGULATA* (FER.)

Dasen[1] in his account of the reproductive system of *Ariophanta ligulata* (Fer.), states that "in the cavity of the 'capsular gland' are found lying freely great numbers of very complex bodies which appear to be extrusions from the glandular wall". In the course of my studies of the reproductive system of some South Indian Pulmonates with special reference to the formation of the spermatophore, I had the opportunity of examining in detail the contents of the capsular gland of *Ariophanta ligulata*, and I find that what Dasen[1] considered to be 'excretory corpuscles' are really Peritrichous ciliate parasites belonging to the genus *Trichodina*. The two sketches given here illustrate the structure of the *Trichodina* found in *Ariophanta ligulata*. Dasen[1] does not seem to have examined the contents of the capsular gland of living specimens of *Ariophanta ligulata*. Had he done so, he would have noticed the so-called 'excretory corpuscles' swimming rapidly with their cilia.

The shape of the *Trichodina* from *Ariophanta ligulata* is best made out in living specimens. Dasen[1] described the 'excretory corpuscles' as resembling 'a finger bowl'. In the living specimen, with the velum extending all round the base, the shape resembles that of a hat, and is intermediate between that of *Trichodina pediculus*, and *Trichodina urinicola*.

A sketch of the basal view of the specimen is given by Dasen,[1] but he mistook the denticulated ring for a 'twisted rope'. As may be seen from the sketches given below, the organisation is typical of *Trichodina*. There is a well developed basal disc, velum, and denticulated ring. The denticulated ring contains about 19 teeth. In *Trichodina pediculus*, Clark[2] states that there are 24 teeth. The meganucleus is horse-shoe shaped and the micronucleus, which is not seen in the view represented in the figures, is imbedded in the meganucleus.

The incidence of the parasite in the capsular gland of *Ariophanta ligulata* seems to vary in the different seasons and also with the locality from which the snails are collected.

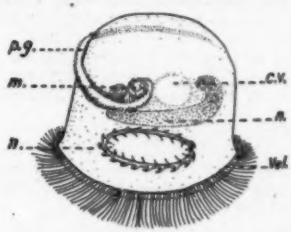


Fig. 1. *Trichodina* sp. from *Ariophanta ligulata* (Fer.), side view. *c.v.*, contractile vacuole; *m.*, mouth; *n.*, meganucleus; *p.g.*, peristomial groove; *r.*, denticulated ring at inner end of basal disc; *vel.*, velum.

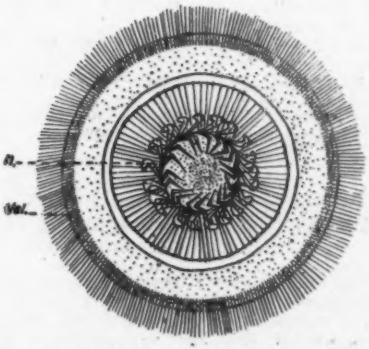


Fig. 2. *Trichodina* sp., from *Ariophanta ligulata* (Fer.), basal view. *r.*, denticulated ring at inner end of basal disc; *vel.*, velum.

From August to November I was able to collect large numbers of the parasites. In the subsequent months I found only few parasites and mostly in the encysted condition. In specimens which were obtained from Madras

the parasites were as a rule much less abundant than those from Nellore District. I may also mention that these parasites are not found in *Ariophanta bistralis* (Beck.).

Bhatia[3] states that the family Urceolariidæ, to which *Trichodina* belongs, has not been recorded so far from India. But Dr. H. S. Rao[4] in his paper on a Brackish-water Actinian, *Pelocoetes* from Madras mentioned the occurrence of *Trochodina* sp. in large numbers in the gastrovascular cavity and often swarming in the cavities of the tentacles.

It is, however, very interesting that species of *Trichodina* should occur in a land animal like *Ariophanta ligulata*. *Trichodina pediculus*, the best known species of *Trichodina* occurs on the body surface of *Hydra*. *Trichodina urinicola* has been found in the urinary bladder of a moribund toad and also in the newt *Triturus*, in the same site. Other species of *Trichodina* have been collected from bodies and gills of fish. Discussing the life-histories of ciliate parasites, Goodrich[5] states: "Fulton suggested that *Trichodina urinicola* may have evolved from forms like *Trichodina pediculus* infesting fish-like ancestors; the ciliates leaving the gills and body surface for the bladder as or before the host left the water". But this theory will not explain the origin of a species of *Trichodina* inhabiting the reproductive system of a land Pulmonate like *Ariophanta ligulata*.

In conclusion I have pleasure in expressing my thanks to Prof. R. V. Seshaiya for guidance and encouragement and to Dr. H. S. Rao for pointing out that a species of *Trichodina* was recorded by him.

Zoology Department,
Annamalai University,
Annamalainagar, P. N. RAJAKRISHNA MENON.
March 30, 1944.

1. Dasen, D. D., *Proc. Zool. Soc. London*, 1933, **103**, 97. 2. James-Clark, H., *Ann. and Mag. Nat. Hist.*, 1866, **17**, 401–25. 3. Bhatia, B. L., "Fauna of British India," *Protozoa: Ciliophora*, 1936, 395. 4. Rao, H. Srinivasa, *Journ. and Proc. As. Soc. Bengal* (n.s.), 1924, **20**, 344. 5. Goodrich, H. Pixell, 'Life-Cycles of Certain Infusoria with Observations on Specificity in Parasitic Protoza.' in *Evolution* (edited by DeBeer, G. R.), 1938, pp. 231–34.

BURNT PADDY-HUSK FOR THE CONTROL OF INSECTS IN STORED FOOD GRAINS

RECENT investigations by Briscoe,[1] Parkin[2] and others have shown that certain kinds of finely-ground dusts of natural minerals like Flint, Felspar, Silica, Dolomite and Limonite and flue dusts from power stations and blast furnaces and power-station Clinker, act as very efficient checks against weevils infesting wheat when the dusts are mixed intimately with the grain.

Observations made by the senior author, of the methods of storing grains, followed in the interior villages of the Malnad areas, led to an investigation of the efficacy of burnt paddy husk in the control of insects affecting different grains. It was found that burnt paddy husk, in finely powdered form (100-mesh to the inch), when thoroughly mixed with jola, rice, wheat and horse-gram at the rate of 1 per cent. of the weight of the grains, adhered to them exceedingly well and caused a high percentage of mortality of the insects. In a series of experiments, in Petri dishes, jars and gunny bags (holding one seer of grain) the following rates of mortality were observed:—

Grain	Insect	Average percentage of mortality
1. Jola ..	Weevil: *Calandra oryzæ*	86·3
2. Rice)	Beetle:	
3. Wheat) ..	(*a*) *Rhizopertha dominica*	100·0
	(*b*) *Tribolium* sps.	68·4
4. Horsegram	Beetle: *Bruchus chinensis*	100·0

The larval stages of *Tribolium* and *Bruchus* beetles in their tunnels inside the grains, have also been found to be affected. Sound grains (free of insects) mixed with burnt paddy husk powder, also repelled the insects to a marked degree.

The removal of the powder from the grains offered no special difficulty, since, ordinary winnowing and sieving and the usual cleaning or moistening with water prior to cooking for consumption, are found sufficient to render the grains free of the powder.

As paddy husk is commonly available everywhere, its use makes the problem of control of insects affecting stored-grains very easy, cheap and simple. The chances of 'silicosis' in the use of this powder, are very much less than in the case of the powders of pure minerals and 'clinker'.

Further work on a large scale is in progress. Fine powders of burnt husk of other cereals and some pulses are also being tested.

Department of Agriculture,
Bangalore, M. J. NARASIMHAN.
June 14, 1944. B. KRISHNA MURTHY.

1. Briscoe, H. A. V., "Some New Properties of Inorganic Dusts," *J. Roy. Soc. Arts*, **91**, (4650). 2. Parkin, E. A., "Control of the Granary Weevil with Finely Ground Mineral Dusts," *Ann. Appl. Biol.*, March 1944, **3**, No. 1.

RELIEF FOR SCIENCE TEACHERS

THE appalling position of science teachers, particularly of those serving in non-Government institutions, whose emoluments even during peace-time were hardly adequate for their sustenance, has been brought home through an ever-increasing number of letters which reach me daily from all parts of India.

A large majority of them are ill-paid and do not receive even the meagre "Dearness Allowance" to which their less unfortunate brethren in Government employ are entitled. Their position which has always been acute, has become distressing since the beginning of 1943 due to racketeering in prices of foodstuffs and rents and the picture of pauperism aggravated by extortionate merchants and landlords, presented in these letters, has impelled me to come out into the open and appeal to the philanthropic public to come to their relief.

The position of the school teachers is rendered lamentable in view of the circumstance that no organization exists in this country to bring their case to the attention of the public. The tragedy is that nobody thinks of them; nobody knows that they need help. What is in fact, a front line tragedy, remains scandalously neglected, even unnoticed. The need for bringing them succour is no less urgent, no less pressing, than, for instance, for the working journalists; but there is no organization like the All-India Newspaper Editors' Conference, to espouse their cause.

Humanitarian considerations demand that the lot of the school teachers should be alleviated. Teaching is one of the most ancient and noblest professions and the teacher fulfils a very important and vital role in the body politic. During the war years, the teachers, particularly the science teachers, have trained a large number of students to man the fighting services, the ordnance factories and industrial establishments. Is it too much to hope that in this country, where charity to the deserving is enjoined on every citizen as a religious duty, the industrialists and philanthropic trusts would come forward for relieving the suffering of the teachers, who are on the brink of destitution?

I am enclosing herewith a representative letter* which I have received from one of my old pupils, Mr. Dhirendra Mohan Mukherji, which will lend support to what I have expressed in the letter. I hope you will give your closest attention to this question and see if a plan could be evolved to give some relief to the poor science teachers.

Office of the Council of Scientific and Industrial Research,
Delhi, S. S. BHATNAGAR.
June 1, 1944.

* Extracts from the letter referred to above.

"I DO not know whether you are aware of the fact that for more than a year and a half the teachers of non-Government colleges in Bengal are engaged in a mute struggle to save their prestige as teachers. For obvious reasons they cannot go about stating their adverse conditions and begging for private or public help. If some of them have received any dearness allowance it is so meagre and so disproportionate with the manifold rise in the price of essential commodities that they are finding it increasingly difficult to maintain themselves and their families on their petty pre-war salaries.

The Government of Bengal have not found it possible to help in any way the teachers of non-Government colleges. The political organizations have not extended their help to those poor educators of young minds.

Apart from any humanitarian considerations these teachers, especially those of scientific subjects, have a right to live in British India because they are steadily supplying a good number of workers for the ordnance factories and other industrial organizations directly connected with the war effort.

The day is fast approaching when most of these science teachers will have to face starvation. Would it not be a matter of disgrace on the part of the renowned Indian Scientists if they fail to move in an attempt to bring relief to these honest teachers?"

CYCLEWELDING—A NEW BONDING PROCESS

PERFECTION of a new process, called "Cycleweld adhesive process", that will stick structural parts more firmly together than they can now be riveted or spot-welded, represents the successful culmination of a joint venture of two United States firms, the Goodyear Company and the Chrysler Motors Corporation. It is expected to speed up production as well as to simplify the manufacture of structural parts. While its present application is expected to be chiefly in the aviation field, many post-war uses are anticipated for it.

The Cycleweld adhesive process has two types of application. One is to bond vulcanised or synthetic rubber to metals or plastics. The other is to bond metal to metal, wood or plastics. It is the bonding of metal to metal that is most important at the moment. In both cases, the process is essentially the same and depends upon the use of newly developed cements, the composition of which is being kept secret for the time being. The proper cement is applied to the surfaces to be bonded together and "cured" in a suitable furnace under considerable heat and pressure. In the case of the metal to metal bond, the cement has been developed into the form of a film or tape. It is merely necessary to place this tape between the parts to be bonded together and then apply heat and pressure. The process of bonding metal to metal lends itself particularly to the bonding of light sheet alloy parts such as aircraft parts made from aluminium or magnesium alloys.

In comparison with riveting and spot-welding, cyclewelding shows both superior strength under static load and in resistance to vibrational stresses. In every use of cyclewelding, whether metal is being bonded to metal, or synthetic rubber to plastic, the result is a bond stronger than the materials bonded together. Post-war uses foreseen for the Cycleweld adhesive process include the making of composite articles of metals and plastics and the sheeting of wood with thin corrosion-resistant metals for the manufacture of automobile bodies, furniture, houses, etc.

REVIEWS

A Shorter History of Science. By Sir William Cecil Dampier (formerly Whetham), F.R.S. (Cambridge University Press) 1944. Pp. 189. Price 7*sh.* 6*d.* net.

This admirable booklet should reach the hands of all science students and mature middle-brows intent on filling a probably wide gap in their general knowledge. The structure and behaviour of matter are second in importance only to the spirit infusing them; and it is the wonderful fabric of modern science, patiently woven throughout the ages from religious beliefs, pagan philosophies, ingenious theories and crucial experiments that the author presents in close pattern: An expanding universe, for "science did not germinate and grow on an open and healthy prairie of ignorance, but in a noisome jungle of magic and superstition, which again and again choked the seedlings of knowledge." (p. 5).

It is not reasonable in war-time to expect so compendious a work to be slip-free. Robert Boyle (1627-91) was "the father of modern chemistry and brother to the Earl of Cork", not uncle (p. 65), for he predeceased his older brother, the second earl (1612-98). The names of the two French chemists, C. L. Berthollet (1748-1822) and M. P. E. Berthelot (1827-1907) have confused others before the author, who succumbs to this notorious trap by recording both as "Bertholet" (pp. 104, 108), indexing one only. Whilst the rare gases of the atmosphere are duly catalogued, it seems a pity that Ramsay and Rayleigh should be missing from an excellent index which embraces Venus and Adonis.

These, however, are only trifling blemishes in a thoroughly commendable introduction to a vast subject, whose importance to mankind grows with each enlargement of its frontier. They are mentioned in the hope that many succeeding editions may be required, because the author provides a wide range of skilfully classified information and an attractive stimulus to further study.

M. O. F.

Geology for Everyman. By Sir Albert Seward. (Cambridge University Press), 1943. Pp. xi *plus* 312. Nine plates and ten text-figures. Price 10*sh.* 6*d.* net.

There is a certain poignancy attached to this publication because it is the last book to be written by that eminent and versatile naturalist, Sir Albert Seward. He had completed writing the manuscript just three days prior to his sudden death. The aim of this book as stated by Sir Albert himself in the introductory chapter, is "to present a case for the inclusion of an intelligent interest in geology as part of that intellectual equipment we call general culture". He does not intend that the book should serve as an elementary text-book, but as an introduction to a branch of natural knowledge which could serve as a fascinating hobby, and according to Sir Albert, "a hobby, to be satisfying, must demand a certain amount of mental effort and should be such as can be progressively pursued until a stage is reached when a desire to know more opens up a prospect of work of one's own in a small patch of an unlimited field, modest in scope yet enthralling enough to produce the pleasant feeling of self-forgetfulness in research".

The opening chapters of the book are devoted to certain aspects of speculative geology, such as the constitution of the interior of the earth, and the origin of continents and oceans. The processes of dynamical geology, resulting in unceasing destruction and construction, are next briefly dealt with. Then follows a concise description of the more important sedimentary, metamorphic, and igneous rocks. The distribution over Britain of the various geological formations is next indicated, and a small-scale geological map of Britain helps the reader in following the descriptions which are presented in the novel manner of a series of traverses across the British Isles.

The bulk of the book deals with historical geology and as an introduction to this, there is a short chapter entitled "Medals of Creation" in which is given interesting information on what a fossil is, how it is preserved, of what value it is to the stratigrapher, and on the light it throws on problems of evolution, geographical distribution of plants and animals throughout the world, and climates of former periods.

Contrary to the usual method adopted in books dealing with historical geology, Seward follows a reversed chronological order, beginning with the latest deposited rocks instead of with the earliest. The description, therefore, starts with the Ice Age and with the conditions which prevailed when primitive man first inhabited the earth. Moving back in the scale of time, the long panorama of the earth's history covering hundreds of millions of years, is unfolded in simple but forceful language. Those who have read through this book which delineates "the pages of a chronicle far transcending human history" may well say with justification, "We have voyaged over strange seas, gathered scraps from the littter of woodland and forest that gave colour to changing landscapes; we have explored 'the stormy bases of the world' and 'the dust of continents to be'. To our vision has been given a greater power of penetration; we have read a little of the Epic of Creation and, little though it is, we have been brought nearer to a perception of the infinite".

The book is well printed and illustrated by eight plates on art paper and ten text-figures, with a very good portrait of the distinguished author as frontispiece. Written in charming language with numerous apt quotations, this book will long remain as one of the best popular introductions to the science of geology.

C. S. PICHAMUTHU.

Records of Department of Mineralogy. Professional Paper No. 1. By D. N. Wadia. (Government of Ceylon), 1943. Pp. 38.

The Ceylon Department of Mineralogy was organised afresh in 1939, replacing the old Mineral Survey Department which, since 1903, had been functioning with intermittent breaks. For the re-constituted Department, the Ceylon Government were fortunate to secure the services of Mr. D. N. Wadia—the well-known eminent Indian geologist—who had just then retired from the Geological Survey of India. As soon as he took charge of the Department, as Government Mineralogist, he started a systematic geological survey of Ceylon, which is being continued still. Naturally it would take some time to complete this detailed survey and bring out a comprehensive memoir on the Geology of Ceylon. In the meanwhile, he has planned to publish the results of the present investigations by periodic issues of professional papers of which the one under review forms the first in the series.

In this handy publication which consists of four sections, Mr. Wadia deals, in the first three sections, with the rare earth minerals of Ceylon, the origin of the graphite deposits, and the three superposed peniplanations, respectively; and in the fourth, he gives a bibliography of the Geology of Ceylon.

The first section opens with a concise account of the Archæn Complex of Ceylon which, forming the source of the rare earth minerals, covers nearly 9/10 of the surface area of the Island. This complex, as in the adjacent mainland of the Indian Peninsula, consists of gneisses and granites underlying a thick series of intensely altered sediments,—now in the form of crystalline schists and granulites comparable to those of the Dharwar System of the Deccan. The latter group is provisionally called, in Ceylon, the Khondalite System, Taprobane System, and Serindeb System, and consists of several rock types which have undergone intense plutonic metamorphism.

The gneisses, though showing some minor variations, are mostly biotitic with occasional hornblende; and they are intimately associated with granites of two or three different intrusive periods, often forming composite gneisses and migmatites.

The rare earth minerals, now found associated with the Khondalites and the alluvial deposits derived from them, are believed to have had their source in the igneous plutonic intrusives, crystallising to a small extent directly from the molten magma as fine disseminated particles, but mostly as coarser segregations in the pegmatites, veins, pipes, etc., as products of pneumatolytic action. There are altogether some 38 types of these minerals which have been briefly described in the paper.

In Section II is given a concise account of the physical and chemical characters, the mode of occurrence and association, and the paragenetic relations of graphite. This section includes 8 plates which illustrate clearly the occurrence of graphite as in infillings, branching veins, rosettes, etc. Discussing the origin of the vein deposits of graphite, Mr. Wadia states that they have resulted from infillings of pre-existing fissures, as intrusive veins and dykes, the graphite having been injected or squirted into fissures in the zone of sheared rocks. The author attributes a magmatic source to the graphite deriving its origin from the absorption of carbonaceous strata by intrusive masses of Charnockites and other related igneous rocks. During this process, it is explained, the calcareous base of the invaded limestone would be converted to lime silicates, and the liberated carbonic acid,—under high temperature and pressure—would be dissociated into gas or liquid carbon or reduced to graphite in the presence of hydrogen. The reviewer is glad to say that this explanation of the origin of the vein graphite in Ceylon conforms, more or less, to what he had expressed some years back in discussing the origin of a small vein deposit of graphite in Mysore.

In Section III, Mr. Wadia describes the three superposed peneplains of Ceylon;—the first forming the coastal plains ranging from 0-400 feet above sea level, the second reaching its maximum altitude up to 2,500 feet, and the third attaining its maximum altitude of 8,300 feet. The author regards the formation of these three superposed peneplains as the result of normal block faulting and successive block uplifts of the peneplained Archæn terrane, in two stages, and not due to the ordinary denudation of dip slopes as had been previously suggested by Adams; and in support of his view he adduces several field evidences.

The last section gives an extensive bibliography containing references not only to all the important papers which have been published on the Geology of Ceylon but also to a few papers which describe the allied rock formations in the adjacent mainland of Peninsular India.

The paper, on the whole, gives an interesting account of some aspects of the Geology of Ceylon and its important minerals, and further contributions from this author on the results of his investigations relating to the origin of the Charnockites and other rock types of Ceylon would be eagerly awaited.

B. Rama Rao.

Matter and Energy. By V. Venkatarao, Maharaja's College, Vizianagram. Pp. 98. Price Annas 8. Copies available with the author. Language Telugu.

This is the fourth of a series published by the author. The booklet is written in Telugu and deals with the results of modern research in respect of constitution of matter and energy. It is a direct result of the ambition on the part of the author to bring the currents of modern scientific thought within the easy reach of the individuals who are proficient in the different modern Indian languages but not so well conversant with English.

The booklet forms an interesting and lucid reading to a scientific person but it is somewhat doubtful whether it will make a lasting impression on the mind of a lay reader. Results of research of master scientists like Rutherford, Bohr, Compton, Raman and others are described in simple Telugu. The choice of expressions, though very good in many places, is not quite apt throughout. S. B.

An Introduction to Pollen Analysis. By G. Erdtman. (Chronica Botanica Co., Waltham, Mass., U.S.A.; Calcutta: Messrs. Macmillan Co.), 1943. Pp. 289. Price $5.

The science of pollen analysis is of comparatively recent origin. Within few years this young science has developed very rapidly and has perfected its technique and analytical methods to a surprising degree. Modern pollen analysis can be said to have begun in 1916, with the publication of L. Von Post's paper on "Fossil Pollens of Swedish Bogs". Some aspects of this science may be traced to a much earlier beginning but the more critical and modern aspect should be reckoned to have begun with Von Post's paper referred to here.

The utility of this science in throwing light on the past history of the vegetation of certain parts of the globe was doubted at one time by scientists of the orthodox school and those sceptical of the new line of approach. However, this science has grown out of this suspect stage and has established its claim to interpret correctly and to draw valid conclusions just as much as any other science seeking to do it. Thus pollen analysis has come to be an additional tool in the hands of botanists to throw light on the past history of vegetation, besides its being of considerable help in studying the trend of changes in floras of the present age.

A perusal of Dr. Erdtman's book on pollen analysis reveals how carefully this new science has been organised and the detailed extent to which the work has been systematised. This is not to say that the science has entirely perfected its analytical methods. That it is not so, is evident, from the warning the author has given in his preface. He emphasises the importance of paying greater attention to pollen morphology instead of as at present relying on empirical techniques. The book has been clearly written and even a beginner will find it easy to follow and pick up the methods. After tracing the history of the development of the science in the introductory chapter, one whole chapter is devoted to the chemistry of peat. This is necessary since it is with the formation of peat and its deposits that much of the work of pollen analysis has been concerned. Preparation of pollen and fossil pollen-bearing material occupy a chapter each. Morphology on which the author places so much emphasis occupies the greater part of the book. The publication is profusely illustrated with detailed diagrams of pollens and spores of many species of angiosperms, gymnosperms and pteridophytes. The elaborate manner in which the spores have been drawn and the details to which the characteristics of the exine and the intine have been illustrated, deserves appreciation. Analyses and graphic presentation of the result, which forms the most important part of the book and on the understanding of which would depend the correct interpretation of the results are fully explained. Some examples have been given of correlating the age and sequence of certain plant deposits, widely separated from each other, with the aid of pollen stratigraphy. Similarly the importance of pollen anlysis in the correlation of facts in palæoclimatology, geology and archæology are indicated. Pollen output and its dissemination, so very important to the science of pollen analysis, is adequately explained. A chapter on pollen flora of peat samples deals with different aspects that need consideration before any conclusion could be drawn from their studies. There is a brief chapter on the importance of pollen analysis in investigations on pollen grains of tertiary deposits.

Although a major portion of the book is in a sense palæobotanical in character, a chapter on pollen analysis of honey and drugs, however, unrelated to the major context of the book, has been added to indicate the importance of this new branch of botanical science. The countries in which pollen surveys have been undertaken have been listed and it is interesting to find that India is mentioned. Authors index and index of plant names form useful additions to the book.

It is natural that a great many investigators in the science of pollen analysis belong to countries of the North Temperate Zone which are rich in extensive peat deposits and fossil pollen-bearing stratas. It cannot be doubted that this science will play a very important role in tracing the past history of the vegetation of temperate countries, But it is, however, hazardous to pass any opinion as to the possible application of this science in countries of the tropics and the sub-tropics. It is possible that from pollen analysis will emerge the pollen systematics, analogous to plant systematics. Such a systematics when established would be of use in the identification of plants without recourse to other grosser parts.

Like all American publications, the printing, get-up and the paper used in this book leave nothing to be desired. L. S. S. K.

CENTRAL SUGARCANE COMMITTEE

THE Government of India have decided to set up a Central Sugarcane Committee which should undertake the improvement and development of the growing, marketing and manufacture of sugarcane and its products in India. This includes items such as agricultural, technological and economic research in sugarcane, gur, sugar and their bye-products, the improvement of crop forecasting and statistics, the production, distribution and testing of improved varieties, the adoption of improved cultural practices, inquiries and recommendations relating to banking and transport facilities and transport routes and the maintenance of an Institute of Technology. The Committee will inform the Central and Provincial Governments concerned on any points which may be referred to it by them, provided the subject-matter of the reference falls within the prescribed functions of the Committee. The members of the Committee will be 45 and include representatives of growers, manufacturers and traders.

The Government of India will finance the Committee by placing at its disposal the entire proceeds of the Sugar Excise.

SCIENCE NOTES AND NEWS

The Bituminous Coal Institute has announced that a new sulfa drug "Phthalyl sulphathiazole" renamed sulfa-halidine, has been discovered which is said to be the most effective intestinal antiseptic yet found. It will probably be highly effective in treatment of infections like bacillary dysentery, a scourge of hot countries like India. Extensive laboratory tests at Texas University Medical School proved that even after a prolonged series of treatments laboratory animals evidenced no toxic effects.

At a Conference recently called by the Imperial Council of Agricultural Research to consider ways and means of improving the quality of fruit products manufactured in India, it was unanimously agreed that legislation should be undertaken to ensure that fruit products manufactured in India conform to certain standard of hygiene and quality. Until such legislation was enacted, it was suggested that manufacturers should adopt the "Agmark" system under which certain conditions and standards of manufacture are laid down. The Conference agreed that a levy of Re. 1-4-0 for 100 labels of 'Agmark' should be collected and the income utilised for the maintenance of a suitable inspection staff and for carrying on the necessary propaganda so that the public may be sure of obtaining articles of quality manufactured under hygienic conditions.

A Technical Mission from the United Kingdom, headed by Mr. G. S. Gowing of the Imperial Chemical Industries Ltd., together with one other member of the Imperial Chemical Industries Ltd., and one of the Power-Gas Corporation Ltd., the latter representing the Association of British Chemical Plant Manufacturers, will visit India to advise on the production of artificial fertilisers for increasing food supplies. The Mission, acting for the Government of India, will undertake the following:—

(1) Investigate and report to the Government of India on the technical problems involved in the manufacture of sulphate of ammonia in British India in quantities up to 350,000 tons per annum.

(2) Recommend, in the light of the raw materials and power available in India, the most economic method of manufacture.

(3) Indicate the approximate capital cost of the plant or plants to be installed, and calculate the approximate cost of operations and production of finished sulphate of ammonia.

(4) Recommend the most suitable site or sites for the erection of the plants concerned, taking into account the raw materials available and the most economic distribution of the finished products.

(5) Estimate the amount and approximate value of plant which it will be necessary to import from outside India making the fullest possible use of materials and labour available in India.

(6) If, for any reason, it should appear that nitrogenous fertilizer, in a form other than sulphate of ammonia, can be more satisfactorily manufactured under Indian conditions generally or locally, consider and recommend from a technical point of view, the most economic method of manufacture of such alternative fertilizer.

(7) Estimate the capital and operating cost of manufacture of such alternative nitrogenous fertilizer.

Sir Azizul Haque, Industries and Civil Supplies Member, is calling a conference of leading industrialists who are expected to visit the U.S. sometime in autumn. The Conference is taking place in Delhi on the 29th instant. The following are among the invitees: Mr. G. D. Birla, Mr. N R. Sarkar, Mr. J. R. D. Tata, Mr. K. Lalbhai, Lala Padampat Singhania, Mr. M. A. Ispahani, Sir Sultan Chinoy and industrialists from Hyderabad.

It is learnt that a British delegation of machine tool experts is expected to visit India in the next cold weather. The delegation will advise the Government on the possibilities of increasing the output of machine tools by establishing or augmenting the machine tool industry in this country. The delegation is expected to stay for about four months.

An American Trade Mission has arrived in London to discuss the supply and distribution of goat skins with representatives of the British Ministry of Supply. The world-wide shortage of leather has brought the problem of co-ordinating supplies to the forefront. At present most of Britain's imported goat skins come from India. In America goats are bred for their hides but not yet on a scale to satisfy the requirements of the country. Developments of breeding and tanning processes will form part of the Missions programme.

To associate public opinion as clearly as possible with Central Government's policy for food administration, the Government have reconstituted the Central Food Advisory Council to advise the Department of Food on matters connected with the production, procurement and disribution of foodstuffs, including the rationing and the nutritional aspects of food supply.

To supplement the food requirements of urban areas, the Government of India have decided to launch schemes for increasing the production and supply of fish as part of their "Grow More Food" campaign. Dr. Baini Prasad, Director of the Zoological Survey of India, has been appointed Fisheries Development Adviser to assist Provincial Governments in preparing suitable schemes of development and co-ordinating the plans on an all-India basis.

The Madras Government have sanctioned the establishment of a Hydraulic and Irrigation

Research Station with experimental models to investigate river training methods, dissipation of energy below drops of canals and allied problems. The research station will be located at Poondi and will, it is expected, begin to function before the end of the current official year.

The decision of the Central Glass and Silicate Research Institute Committee to recommend that the Central Glass and Silicate Research Institute should be located at Calcutta, was announced by Sir S. S. Bhatnagar, Chairman of the Committee, at a luncheon given in his honour. Sir Shanti Swarup expressed his gratification at the keen interest shown in the matter by industrialists and scientists of Calcutta and at the handsome donations promised for the Institute.

Kashmir and Soviet Russia, which have a common frontier recently exchanged certain varieties of paddy. Experiments conducted at the Kashmir Rice Breeding Farm in pursuance of the rice research scheme worked in collaboration with the Imperial Agricultural Research Council, New Delhi, indicate that the Russian variety matures 4-6 weeks earlier than the indigenous variety thereby enabling Kashmir to have two paddy crops annually.

The Senate of the Calcutta University, at its meeting held recently, accepted an annual grant of Rs. 6,000 to the University from the Sir Dorabji Tata Trust for five years towards the recurring expenditure for the maintenance of the Cyclotron laboratory.

The High Commissioner for Australia in India, Lt.-Gen. Sir Iver Mackey, had addressed six of the Universities in India inviting their views on the subject of an exchange of University teachers and students between India and Australia. "It is the opinion of a number of influential Indians and Australians", he writes, "that interchange of students and teachers, besides conferring benefits upon the individuals concerned, provides one of the best means of promoting knowledge, understanding and goodwill between the participating countries. It is with this belief that I submit the matter for your consideration."

The Government of Mysore have donated a capital grant of Rs. 1 lakh for opening a Metallurgical Department at the Indian Institute of Science. A recurring grant of Rs. 15,000 for a period of five years has also been made.

It is announced that the Rockefeller Foundation have made a grant of up to Rs. 15,000 to the National Institute of Sciences of India, as a contribution towards the support of scientific journals in India.

Mr. K. R. Narayanan, a graduate of the Travancore University, has been awarded the Tata Scholarship of Rs. 16,000 for higher studies in England. He will join the London School of Economics to study politics, economics and journalism.

Dr. B. B. Day has been invited to address the Convocation of the Madras University scheduled to be held on the 24th of August 1944.

The Madras University, it is understood, has appointed Dr. Dinshaw R. Nanji, D.Sc. (Bir.), as Professor in the proposed College of Technology. He is at present Consulting Technologist in Birmingham and will be joining the University as soon as passage facilities are made available. Dr. M. A. Govinda Rau, M.A., Ph.D. (Lond.), is the Reader.

The Bombay University has awarded the Rustomji Ranchetji Desai's gold medal for 1943 to Dr. P. L. Narasimha Rao of the Indian Institute of Science, for his thesis on "Synthetical investigation in pinene group".

The ashes of Sir P. C. Ray have been preserved in an urn in his room in the University College of Science, Calcutta. The urn is placed on his favourite cot which he had used for years. It is proposed to preserve the room as a museum exhibiting his books, clothes and a few of his articles of furniture.

The Trustees of the Lady Tata Memorial Trust announce the Awards of the following Scholarships and Grants for the year 1944-45:

I. *International Awards for research in diseases of the blood with special reference to Leucæmias*—

(1) *Prof. L. Doljanski*, of Jerusalem: To continue studies on (i) Leucotic cells and agent of fowl leucosis *in vitro*; (ii) The X-ray susceptibility of leucotic agent; (iii) The cell affinities of oncogenic viruses and the mutual relationship between *Rous sarcoma* agent and agent of fowl leucosis. (*Grant of* £ 400 *third year's Award.*) (2) *Dr. Jacob Furth*, of American nationality, Cornell University Medical College, New York: To continue the work in progress upon the Leucæmias like diseases of fowls and their relation to neoplasms and to determine the nature of viruses producing leucæmias and associated neoplasms lymphomatosis, myelomatosis, endothelioma, sarcomas, etc. (*Grant of* £400, *tenth year's Award.*) (3) *Dr. P. A. Gorer*, Guys Hospital, London: To continue the studies in the genetics of mouse Leucæmia. (*Grant of* £70, *fifth year's Award.*) (4) *Dr. A. H. T. Robb-Smith*, Nuffield Reader in Pathology and Morbid Anatomy, Oxford University: To continue the aid to the establishment of a "Lymphonode Registry" in the School of Pathology at Oxford to aim at better classification and follow-up of human cases showing progressive hyperplasias and neoplasms of the lymphoreticular tissues including cases of leucæmias, lymphadenoma, lymphosarcoma, etc. (*Grant of* £350, *fifth year's Award.*) (5) *Dr. Werner Jacobson*, Part-time Sir Hailey Stewart Fellowship at the Strangeways Research Laboratory, Cambridge: To continue the study of making a histo-chemical study of the argentaffine cells of the gut epithelium, with a view to determining whether they are the source of the intrinsic factor of Castle, and hence their bearing on the problem of pernicious anæmia and other blood diseases. (*Grant of* £300, *seventh year's Award.*) (6) Provisional Grant of £400, to *the worker under Prof. Witts to confirm Dr. Jacobson's research*,

II. *Indian Scholarships of Rs. 150 per month each for one year from 1st July 1944 for scientific investigations having a bearing on the alleviation of human suffering*—(1) *Mrs. Alamela Venkataraman, B.A., M.Sc.*, Haffkine Institute, Bombay: "Synthesis of Sulphanilamide Derivatives." (*Second year's Award.*) (2) *Mr. Arobinda Roy, M.Sc.*, University College of Science, Calcutta: "The Absorption Rate of Different Edible Oils Used in India and the Effect of Vitamins A and D and Hydrogenation." (*Second year's Award.*) (3) *Miss Violet DeSouza, M.Sc.*, Indian Institute of Science, Bangalore: "The Investigation of Strains of Yeast and Other Hybrids as Sources of the Vitamin B Complex." (*Second year's Award.*) (4) *Mr. Narayan Gopal Joshi, B.Sc.*, Tata Memorial Hospital, Bombay: "Vitamin Metabolism in Cancer with Special Reference to Ascorbic Acid and Glutathione". (*First year's Award.*) (5) *Mr. P. K. Bhattacharyya, M.Sc.*, University College of Science, Calcutta: "Investigations on Anti-Bacterial Substances Produced by Moulds." (*First year's Award.*) (6) *Mr. S. Dattatreya Rao, B.Sc.* (*Hons.*), Indian Institute of Science, Bangalore: "Investigations on the Influence of Tocopherol and Fat on the Absorption and Utilisation of Carotene and the Function of Carotene in the Animal System." (*First year's Award.*)

MAGNETIC NOTES

Magnetic conditions during April 1944 were less disturbed than in the previous month. There were 12 *quiet* days, 17 days of *slight* disturbance and 1 day of *great* disturbance as against 12 quiet days, 17 days of slight disturbance and 1 day of moderate disturbance during the same month last year.

The quietest day during April 1944 was the 14th and the day of the largest disturbance the 2nd.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	Great
7, 11, 13, 14, 17–23, 25	1, 3–6, 8–10, 12 15, 16, 24, 26–30	2

One magnetic disturbance of moderate intensity occurred during the month of April 1944 while no magnetic storm was recorded in April last year.

The mean character figure for April 1944 was 0·63, being the same as that for April 1943.

Magnetic conditions during May 1944 were far less disturbed than in the previous month. There were 20 *quiet* days and 11 days of *slight* disturbance as against 13 quiet days and 18 days of slight disturbance during the same month last year.

The quietest day during the month was the 15th and the day of the largest disturbance the 1st.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days
	Slight
3, 5, 8–17, 19–23, 25, 26, 30, 31	1, 2, 4, 6, 7, 18, 24, 25, 27, 28, 29

No magnetic storm occurred during the months of May 1943 and 1944.

The mean character figure for the month of May 1944 was 0·35 as against 0·58 for May 1943.

M. PANDURANGA RAO.

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"Journal of the Royal Society of Arts," Vol. 92, Nos. 4662-64.

"Journal of Agricultural Research," Vol. 68, Nos. 1-4.

"Indian Journal of Agricultural Science," Vol. 13, Pt. 5.

"Biochemical Journal," Vol. 37, Nos. 5-6.

"Journal of the Indian Chemical Society," Vol. 20, Nos. 11-12; and Vol. 21, Nos. 1-2.

"Journal of Chemical Physics," Vol. 11, No. 12; and Vol. 12, Nos. 1-3.

"Chemical Products and Chemical News," Vol. 7, Nos. 3-6.

"Discovery," Vol. 4, No. 11; and Vol. 5, No. 1.

"Endeavour," Vol. 3, No. 9.

"Experiment Station Record," Vol. 90, Nos. 1-3.

"Indian Farming," Vol. 4, Nos. 10-12.

"Transactions of the Faraday Society," Vol. 40, Pts. 1-4.

"Indian Forester," Vol. 70, Nos. 4-6.

"Mathematics Student," Vol. 7, Nos. 3 and 4.

"Indian Medical Gazette," Vol. 79, Nos. 3, 4 and 5.

"The Review of Applied Mycology," Vol. 23, Pts. 1 and 2.

"American Meteorological Society Bulletin," Vol. 24, Nos. 9 and 10; and Vol. 25, No. 1.

"Journal of Nutrition," Vol. 26, No. 6; Vol. 27, Nos. 1 and 2.

"Nature," Vol. 152, Nos. 3866 and 3869; and Vol. 153, Nos. 3873-77 and 3879-87.

"American Museum of Natural History," Vol. 53, Nos. 1 and 2.

"Indian Journal of Physics," Vol. 17, No. 5.

"Journal of Research of the National Bureau of Standards," Vol. 31, Nos. 4 and 5.

"Science," Vol. 98, Nos. 2546, 2549-51, 2553-56, 2558-59; and Vol. 99, Nos. 60-68.

"Journal of Scientific and Industrial Research," Vol. 2, Nos. 2 and 3.

"Science and Culture," Vol. 9, Nos. 10-12.

"Monthly Science News," Nos. 29-33.

"Sky and Telescope," Vol. 3, Nos. 2-6.

"Indian Trade Journal," Vol. 152, Nos. 1965-72; Vol. 153, Nos. 1973, 1974, 1976-81.

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INDIA METEOROLOGICAL DEPARTMENT

Applications in prescribed form will be received up to 30th June 1944 from Muslims, Scheduled Castes and members of Other Minority Communities for the following temporary non-gazetted posts, created in connection with the war :

(i) Meteorological Assistants on Rs. 130-8-210-10-270.

(ii) Assistants on Rs. 100-5-150-10-250.

Age limit 28 years (31 years for Scheduled Castes only) on 30th June 1944 for all posts. Minimum Qualifications: Graduate in Science. Particulars and application forms from the Director-General of Observatories, Lodi Road, New Delhi, by sending stamped and addressed envelope.

NATIONAL REGISTER OF SCIENTISTS

(Under Compilation by the Industrial Research Planning Committee under the auspices of the Council of Scientific and Industrial Research, Government of India)

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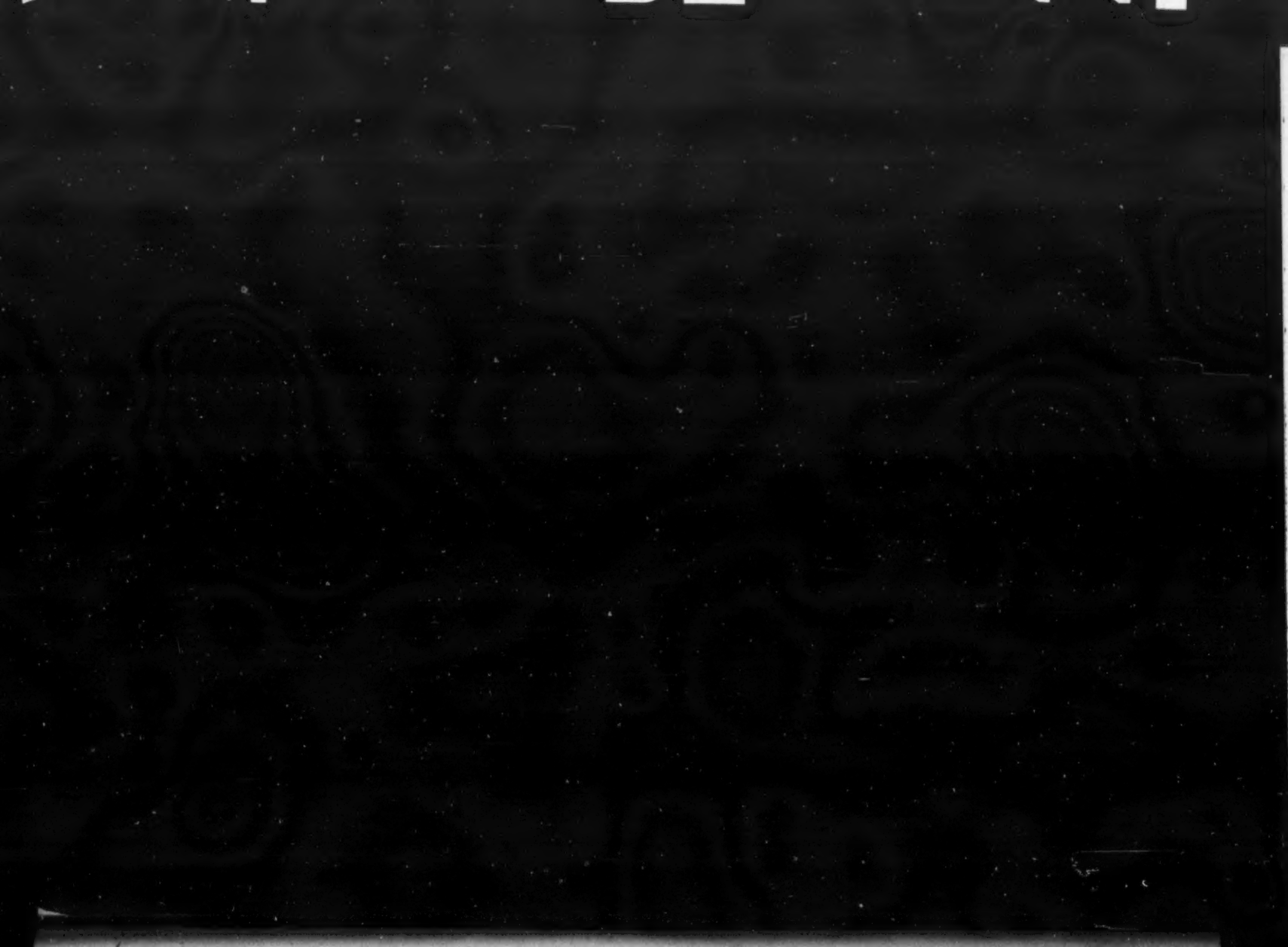
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